

LOUIS RENÉ BARRERA INDIANGRASS WILDLIFE SANCTUARY MANAGEMENT PLAN





ENVIRONMENTAL PLANNING

Integrating Land Use and Natural Systems: Siglo Group uses the power of geographic information to help clients integrate land use with natural systems. Siglo specializes in conservation planning, regional analysis, site assessment, cartography, and spatial analysis. Their work has contributed to land being set aside in perpetuity for conservation, policies and projects that work towards more sustainable land use, good development, and a greater understanding of the attributes and values of land.

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The mission of the Austin Parks and Recreation Department is to inspire Austin to learn, play, protect and connect by creating diverse programs and experiences in sustainable natural spaces and public places.

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EXECUTIVE SUMMARY

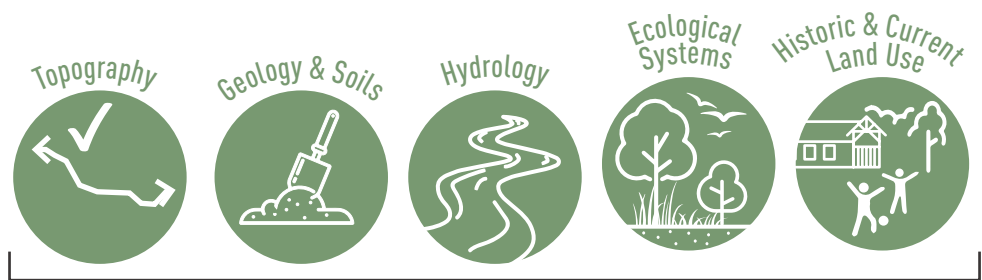
The 281-acre Louis René Barrera Indiangrass Wildlife Sanctuary (Barrera Wildlife Sanctuary) has had a 53-year history of Blackland Prairie restoration while being closed to the public. The Austin Parks and Recreation Department commissioned Siglo Group to develop a management plan to aid land managers in restoring and managing this unique piece of Blackland Prairie. The purpose of this plan is to guide the restoration of resilient grassland plant communities and associated ecosystem functions, enhance the user experience, and improve stewardship. This plan is informed by the Walter E. Long Metropolitan Park Master Plan and is aligned with the city's goals and policies associated with green infrastructure, land management, ecological restoration, and user enjoyment.

This plan includes a site analysis, which provides an overview of the unique characteristics of the site, and natural area management guidelines, which recommends ways to improve ecological function and the user experience. A final section includes an implementation schedule, methods for documentation, and metrics for measuring success. These guidelines proactively address opportunities and issues at the preserve and aim to improve natural areas over the coming years.

To create the Louis René Barrera Indiangrass Wildlife Sanctuary Management Plan, Siglo compiled previous plans and assessments, met with key city staff, collected field data, and performed geographic assessments. Analysis included compilation of records associated with trees, invasive species, soil disturbance, erosion, restoration potential, significant features, photographs, and species occurrences. Primary threats to the site's ecological health include invasive plant species and woody encroachment. The site is divided into management units (Figure 3.2) to organize needs, best management practices, and priorities into implementable tasks with measurable results. Recommended activities include brush clearing, prescribed burning, and seeding with a goal of enhancing native plant communities. Along the shoreline and in the wetland areas, recommended practices include removal of invasive species and planting to establish a canopy of native riparian species while preventing erosion. A suggested maintenance schedule is included to aid in task organization (Figure 4.3).

ECOLOGY & SITE CHARACTERISTICS

Describes unique site elements



X Current and potential **THREATS** to the site's ecological health



NATURAL AREA MANAGEMENT GUIDELINES

Addresses **THREATS** to the ecology of the site

① All Management Units

ACTIONS:

- Clear brush
- Burn
- Seed

RESULTS:

- ✓ Open canopy
- ✓ Reduce invasives
- ✓ Improve diversity

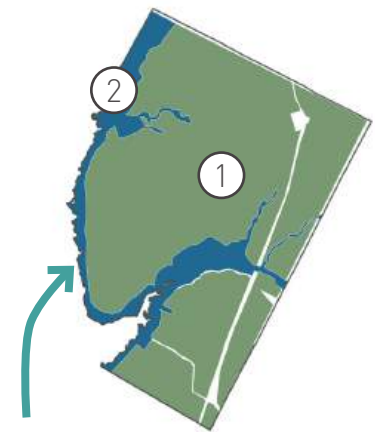
② Lakeshore & Riparian Areas

ADDITIONAL ACTIONS:

- Control invasives
- Replant

RESULTS:

- ✓ Reduce woody invasives



Full Management Area map found in

FIGURE 3.2

See Page 33 for detailed guidance

TOWARD IMPLEMENTATION

Provides a suggested maintenance implementation and rest schedule

① All Management Units

- Clear brush
- Rest
- Burn
- Treat invasives
- Seed
- Monitor

This section also includes:



Documentation Methods

&



Metrics for measuring success

See Page 47 for detailed guidance

FIGURE 4.3

PART 1:

Introduction



Rolling grasslands slope down toward the more densely treed shoreline of Walter E. Long Lake.

The Louis René Barrera Indiangrass Wildlife Sanctuary (Barrera Wildlife Sanctuary) has a 53-year history as part of the Austin Parks and Recreation Department (PARD) system, designated as a preserve and managed for the purpose of Blackland Prairie restoration. It was acquired in 1967, at the same time that the Walter E. Long reservoir was created. Since then, it has been managed by PARD stewards and open to the community through volunteer and educational events and research projects. The ecology of the site faces pressure from climate change and increased development in the surrounding area and will be shaped by the Walter E. Long Metropolitan Park Master Plan. Siglo Group was commissioned by the Austin Parks and Recreation Department to create the Louis René Barrera Indiangrass Wildlife Sanctuary Management Plan to guide restoration of the site in consideration of these and other pressures.

The 281-acre preserve provides habitat for a variety of wildlife, including mammals, reptiles, amphibians, and birds. It also includes a diversity

of plant communities influenced by topographic changes, variation in soils, a history of farming, and more recent restoration activities. The plant communities present on site range from grasslands to riparian and upland woodlands. With the establishment of Barrera Wildlife Sanctuary, the city of Austin protected a small part of the Blackland Prairie ecoregion—one of the most threatened ecosystems in Texas with less than an estimated 1% remaining (Figure 1.1).¹ Because of its fertile soils and flat topography, European settlers converted most of the Blackland Prairie to row crops and pasture. Throughout the 20th and into the 21st century, urban sprawl has converted much agricultural Blackland soil to urban and suburban uses.

By restoring plant communities that are consistent with the Blackland Prairie ecoregion, the preserve can provide many important functions for both site users and nearby residents. These include: maintaining and improving water quality,² sequestering carbon,³ mitigating flooding,⁴ reducing erosion,⁵ building soil,⁶ providing wildlife

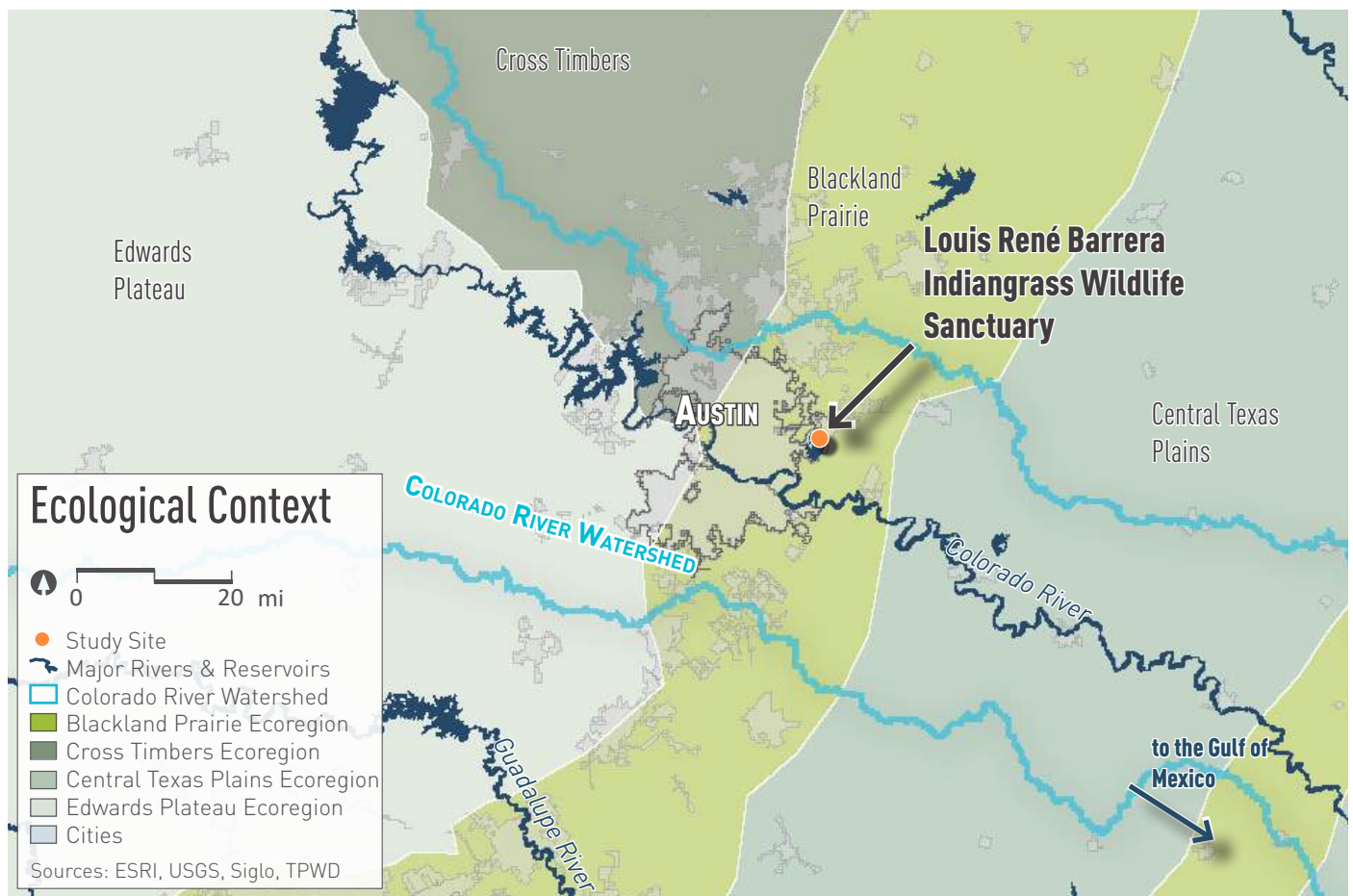


Figure 1.1 Context Map

habitat,⁷ increasing property values,⁸ and providing mental health benefits.⁹ This plan replaces the previous land management plan that was written by Regina Ramos and Ana Gonzales.¹⁰ It considers the site's characteristics and previous history of management to deliver an adaptive management framework. The result of this on-going management not only informs long-term stewardship of the property but can serve as an example for other properties in the Austin parks system.

MISSION AND GOALS

The mission of the Austin Parks and Recreation Department (PARD) is “to inspire Austin to learn, play, protect, and connect by creating diverse programs and experiences in sustainable natural spaces and public places.” The Austin Nature Preserve System, managed by PARD, began in 1935 with the creation of Zilker Nature Preserve. It is currently comprised of 15 preserves encompassing approximately 2,600 acres. The City of Austin classifies preserve land as “a unique type of parkland that contains significant natural communities, species, or unique natural

features, which are managed in perpetuity for the benefit of those features, and to provide aesthetic, educational, and scientific benefit for the people of Austin.” Austin residents also have a strong desire to protect, restore, and manage sustainable natural communities that provide a suite of ecosystem services such as wildlife habitat, water quality and quantity, climate change mitigation, recreational opportunities, solitude, and mental health benefits through access to nature. These desires have been made clear in the PARD Long Range Plan 2020-2030, the City of Austin Strategic Direction 2023, and the 2020 City of Austin Community Climate Plan.

In line with these high-level goals and directives, community intent for the Barrera Wildlife Sanctuary has been well-established over recent decades by numerous community groups, volunteers, partner and granting organizations, and City of Austin staff from several departments working on, and investing in, the site. This intent, and therefore, the management goal for Barrera Wildlife Sanctuary is to **restore the site primarily to Blackland Prairie so that it may provide many of the vital ecosystem services that Austin and its residents need for social, economic, and environmental well-being.**

Historically, the preserve would have had larger areas of open prairie like this one currently found in the southeastern corner of the site.



PART 2:

Site Analysis

- 6 Land Use
- 10 Geology
- 12 Topography
- 14 Hydrology
- 16 Soils
- 18 Vegetation
- 27 Wildlife
- 28 Threats

Indiangrass is an important species in grassland ecosystems of the Blackland Prairie.

The Blackland Prairie ecoregion is characterized by temperate grasslands, rich, productive soils, and high biodiversity.¹¹ It lies east of the Balcones Escarpment, from east of San Antonio to just south of the Red River. It is part of the larger Grand Prairie grassland system and, as a whole, is home to over 500 native species of fauna.¹¹ The Blackland Prairie is the most substantially altered ecoregion in Texas and less than 1% of Blackland Prairie remains intact today.^{1,12} Threats to the Blackland Prairie ecoregion include urbanization, conversion to pastureland, and invasive species, fragmentation, and alteration of fire and grazing regimes.¹¹

LAND USE

HISTORIC LAND USE

Native Americans lived on the Blackland Prairie for thousands of years. They hunted big game and set fire to the landscape in order to maintain wide, open grasslands. They lived off the land—using animal hides as material and supplementing their diets with prairie plants.¹³ Although they manipulated their environment, these activities are not believed to have decreased ecological function of prairie ecosystems and may have actually increased the geographic extent of the tall grass prairie.¹⁴ Extensive alteration of the prairie began in the 1800s when European settlers removed bison, forcibly displaced and relocated Native Americans, converted large amounts of grassland to agriculture, altered fire regimes, and fragmented the landscape with roads and fields.¹⁴

Photographic evidence of the impact of land use on the site is apparent in an aerial photo from the 1940s (Figure 2.1). There are at least four distinct homesteads on this tract of land with as many as 24 fields delineated by cross-fencing (indicated with orange arrows). Additionally, the creeks running through this property show potential indication of erosion, based on what appears to be exposed, light colored, bare substrate (indicated with blue arrows). Many of the same creeks and drainage features can be seen in the 1966 aerial, just a year before the damming of Decker Creek that would

form Walter E. Long Lake and the acquisition of the land that would later become Barrera Wildlife Sanctuary (Figure 2.2). In 1966, there are more woody species, seen as black splotches on the aerial. Additionally, one main creek appears to have widened since 1940 (indicated with blue arrow). Several of the previously inhabited homesteads are no longer visible and many fields appear to have fewer delineations and distinct land uses. In addition, woody species cover continues to increase throughout the site.

Aerial photos from 1984, just 17 years after the formation of Walter E. Long Lake and the acquisition of this land by the Austin Parks and Recreation Department, appear to depict narrowing stream channels (Figure 2.3), which may indicate hydrologic recovery. All homesteads have been removed from the property and the land use pattern is noticeably more uniform than in previous aeriels. Additionally, revegetation of the landscape is apparent. There are several groves of woody plants surrounding the various wetlands on site (indicated by green arrows). It was during this year that the sanctuary committee officially established the site, which was originally called the Indiangrass Wildlife Sanctuary, as a preserve within the Austin Parks and Recreation Department.¹⁵ Since then, the site has undergone numerous changes. With the elimination of agricultural practices on the site and limited land management resources, woody encroachment occurred throughout much of the site. There is also a natural gas pipeline that bisects the site from north to south, along with associated infrastructure near the site's northern border. The mowed pipeline right-of-way is also used as a road within the preserve.

LOUIS RENÉ BARRERA

More recently, the sanctuary has been under the careful management of PARD staff, including its late land manager, Louis René Barrera. René had a special passion for restoring Blackland Prairie habitat and the then-named Indiangrass Wildlife Sanctuary was perhaps the best opportunity within the Austin Nature Preserve System to accomplish that. He dedicated his time to bringing park rangers, cadets, interns, volunteers, and potential

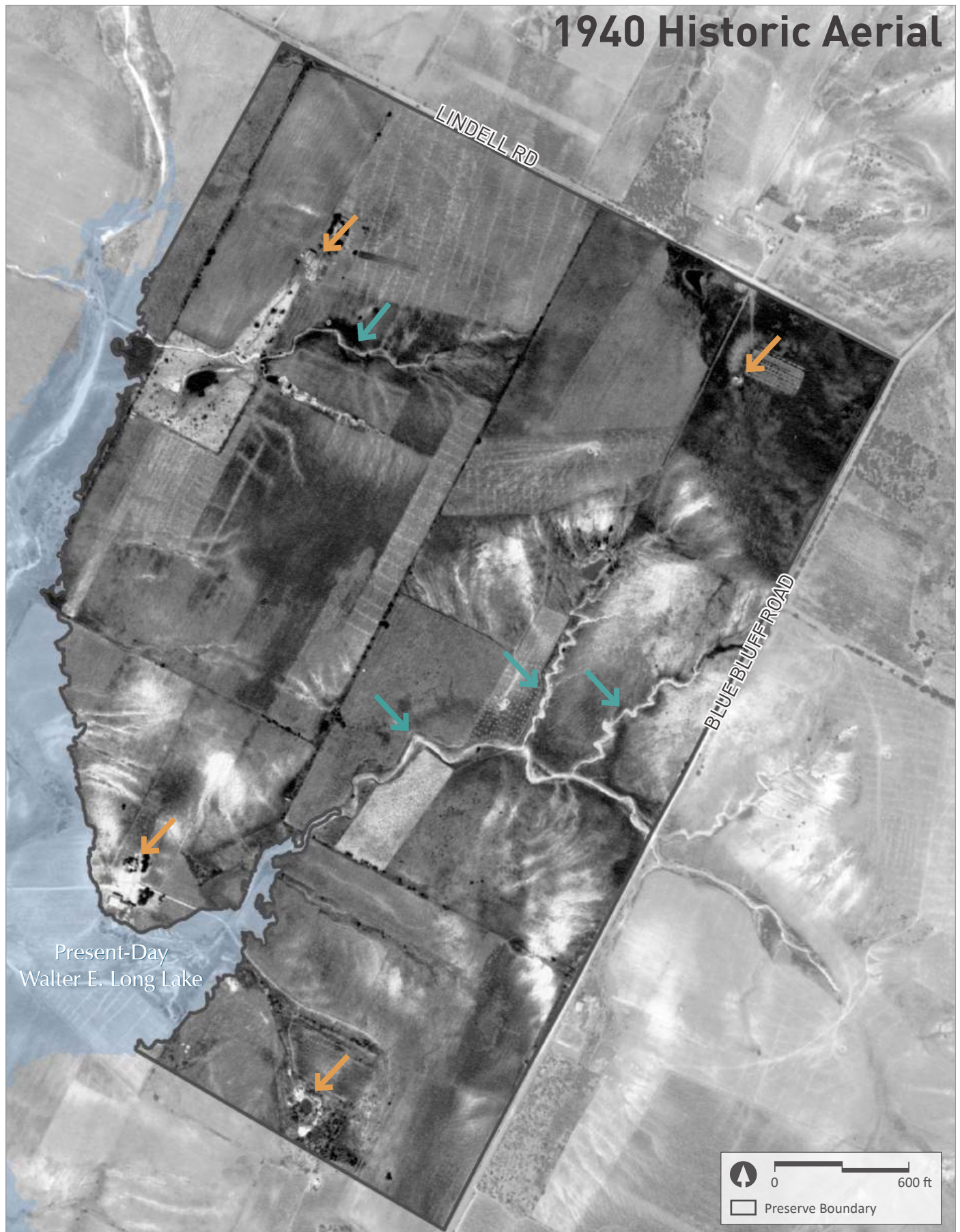


Figure 2.1 Historic aerial photograph taken in 1940. Orange arrows indicate homesteads, blue arrows indicate creeks referred to in the text.

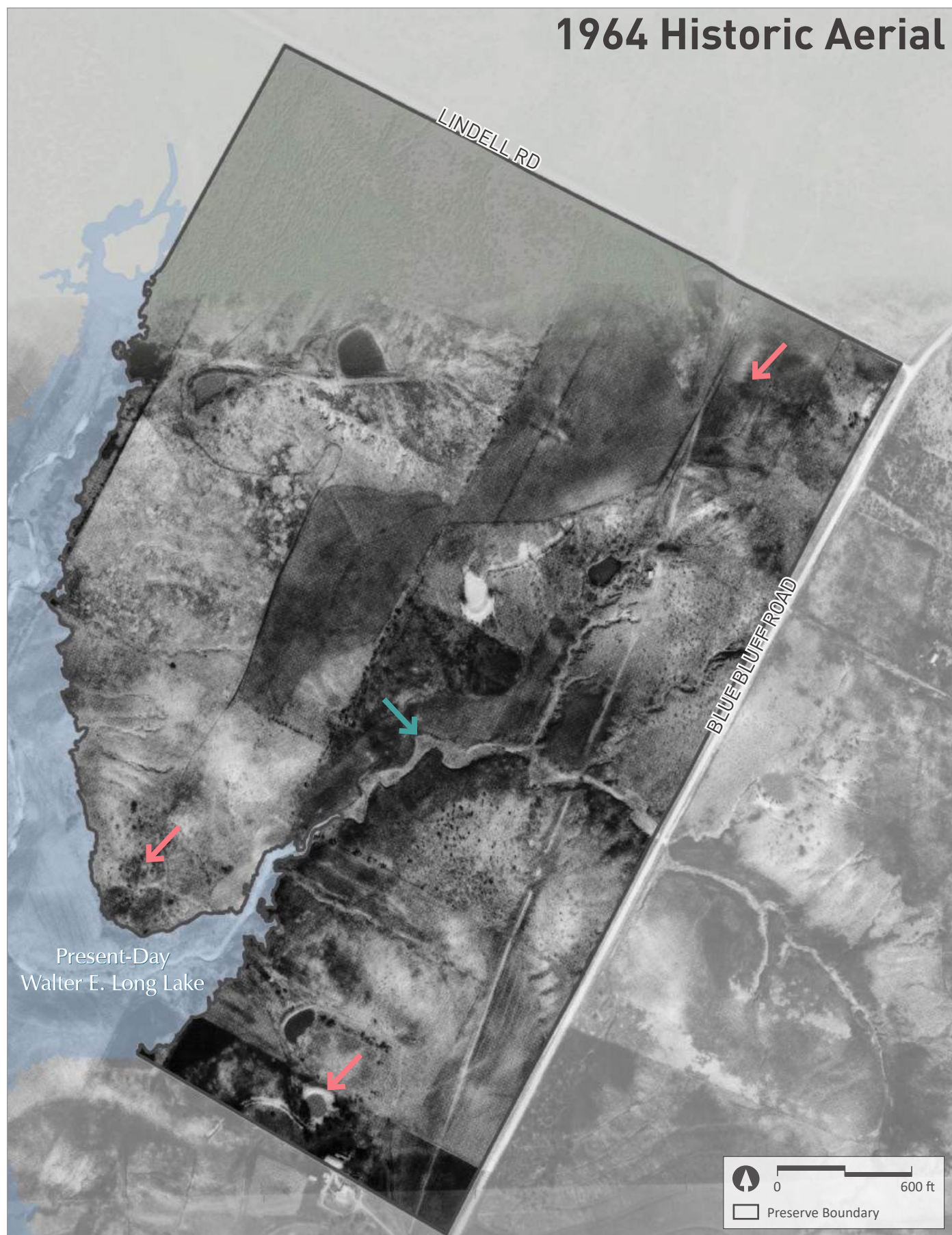


Figure 2.2 Historic aerial photograph taken in 1966. No photo of the northern-most section of the preserve was available. Pink arrows indicate former homesteads, blue arrow indicates the creek referred to into the text.



Figure 2.3 Historic aerial photograph taken in 1984. Blue arrows indicate creeks, green arrows indicate expanding woody vegetation around wetlands.

partners to the sanctuary. During these visits, he led guests on nature hikes, pointing out remnant prairie species and sharing his vision for the sanctuary.

In 2016, he secured a cooperative agreement with the U.S. Fish and Wildlife Service to control woody plants and replant native prairie species in some of the most densely vegetated portions of the preserve. Later, he established a partnership with the Austin Fire Department Wildfire Division to use the preserve for wildland fire training as well as to implement prescribed burns for restoration purposes. He also began a collaboration with the Native Prairie Association of Texas, who held monthly volunteer workdays on-site. These workdays established an enthusiastic workforce to help with labor-intensive management activities. In 2018, he secured a grant to support prescribed burn work and the purchase of a seed drill. This allowed PARD staff to scale up seed planting.¹⁶

Over more than two decades with the Austin Nature Preserves, René became known as one of the city's most dedicated and resourceful land managers and advocated for the stewardship of natural systems. Because of his dedication to the land, the preserve was officially renamed the Louis René Barrera Indiangrass Wildlife Sanctuary in 2019.

FUTURE LAND USE

The Walter E. Long Metropolitan Park Master Plan, released in September 2019, contains plans for the future development of the Walter E. Long Metropolitan Park as a whole, including Barrera Wildlife Sanctuary. The plan includes opening the sanctuary to the public for the first time, along with a variety of potential infrastructural changes including new trails and buildings. The sanctuary will, however, continue to be managed as part of PARD's preserve system, whose purpose is to manage natural areas to provide vital ecosystem services sustainably and resiliently to Austin and its residents.

Industrial and residential development will likely occur north and northeast of the Barrera Wildlife Sanctuary, as identified during the Walter E. Long master planning process (Appendix 1).¹⁷ This may

result in increased stormflow to the preserve, potential deterioration of water quality, and a higher visitation rate. Therefore, water flow through the property and trail planning will be important components of the planning process moving forward.

Trail development could have a significant impact on the sanctuary (Appendix 2). Proposed visitor entrance points in the northeast and southeast corners of Barrera Wildlife Sanctuary will have implications for site use patterns.¹⁷ However, it should be noted that these proposed access points have yet to be officially approved and are subject to change. There is also a series of trails that is intended to connect the entirety of the Walter E. Long Metropolitan Park and will pass through Barrera Wildlife Sanctuary. In the current plan, the proposed trails pass over the three main hills of the Barrera Wildlife Sanctuary property, with one separate loop trail through the riparian area along the shoreline. One major consideration is that both the trail system and a future entrance point pass through a densely wooded area in the northeast corner of the property (near the intersection of Blue Bluff Road and Lindell Lane) that is not slated for burning, due to land managers' desire to keep it as a control plot. If the final master plan is to move forward as is, the management of this wooded area may need to be reimagined.

Additionally, a public survey of desired programmatic uses revealed that top preferences are multi-use trails, picnicking, nature discovery, open space, water recreation, wetland restoration, and wildlife observation.¹⁷ These can be used to drive future land use planning and educational programming.

GEOLOGY

Geology influences hydrology, soils, and habitats. Most of the preserve is underlain by the Undivided Navarro and Taylor Geologic Groups. Small areas of High Gravel Deposits occur in the northeast and southeast corners (Figure 2.4).

Undivided Navarro and Taylor Groups are predominately composed of silty clay sandstone.¹⁸

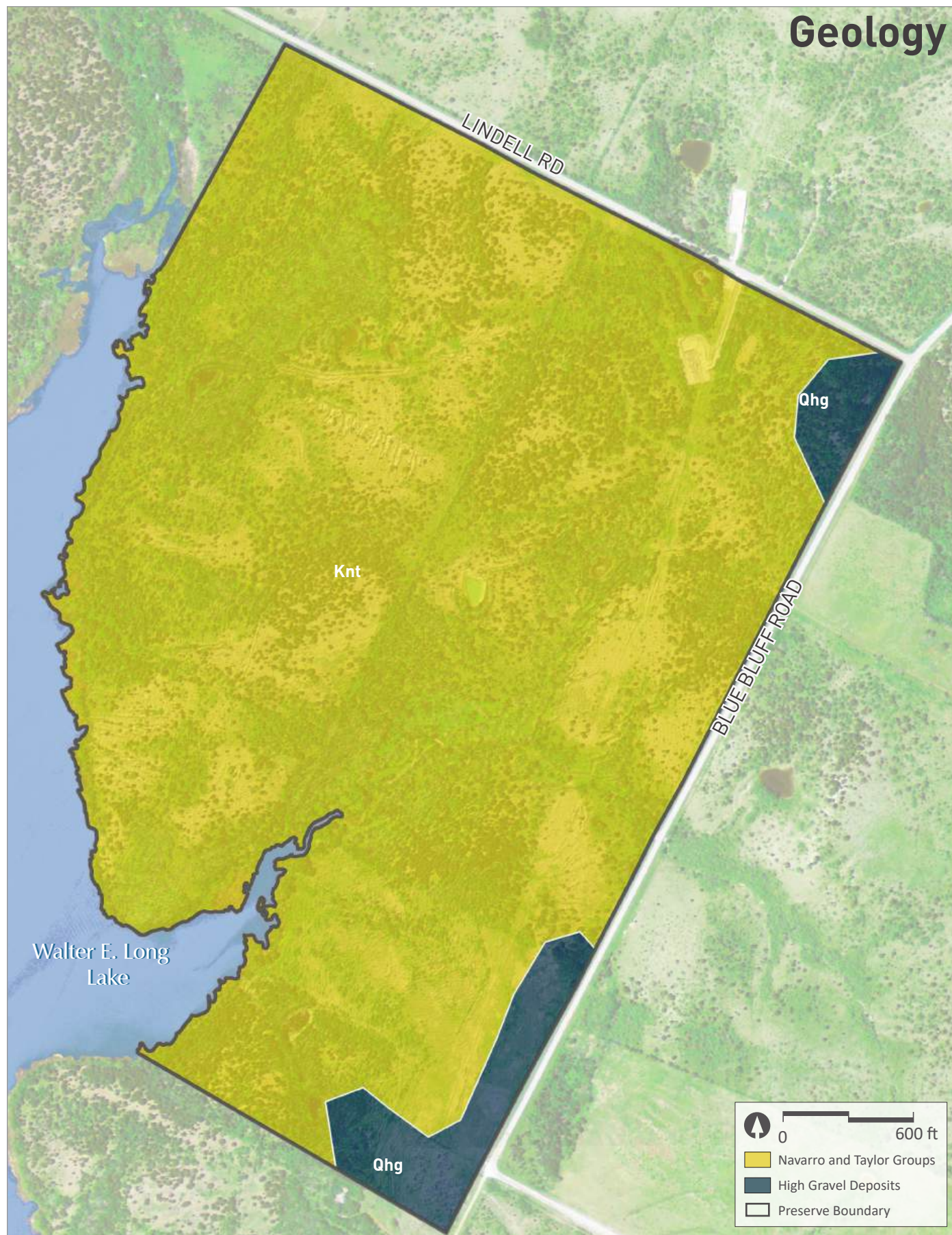


Figure 2.4 *Geologic formations*

The Navarro Group notably produces low, undulating slopes and extends from the Barrera Wildlife Sanctuary east to Elgin, where it underlies the easternmost portion of the Blackland Prairie ecoregion. The Taylor Group is often characterized by low-relief prairies.¹⁹ These geologic formations are easily eroded by streams.¹⁹ Therefore, areas underlain by Taylor Group formations tend to have a highly branched drainage pattern.

High Gravel Deposits are considerably younger than the Navarro and Taylor Groups, originating during the Pleistocene, approximately 2.58 million–12,000 years ago.²⁰ These deposits are found close to the soil surface on two hilltops on the eastern perimeter of the sanctuary and within floodplains. They are the result of moving water that has weathered, carried, and deposited fragmented rock across the landscape.²⁰

TOPOGRAPHY

Topography is affected by geology and hydrology (Figure 2.5). All areas that are underlain by Navarro and Taylor Geologic Groups are characterized by low, undulating slopes (generally <15%). The site generally slopes east to west toward the Walter E. Long Lake shoreline, where the elevation is around 555 feet. There are three hills on the property. The highest one, at 644 feet, lies in the northeastern corner of the property. Another lies in the southeastern corner of the property with an elevation of 632 feet. The third is situated in the site's center and has an elevation of 616 feet.

The topography of the site is characterized by gently undulating slopes.



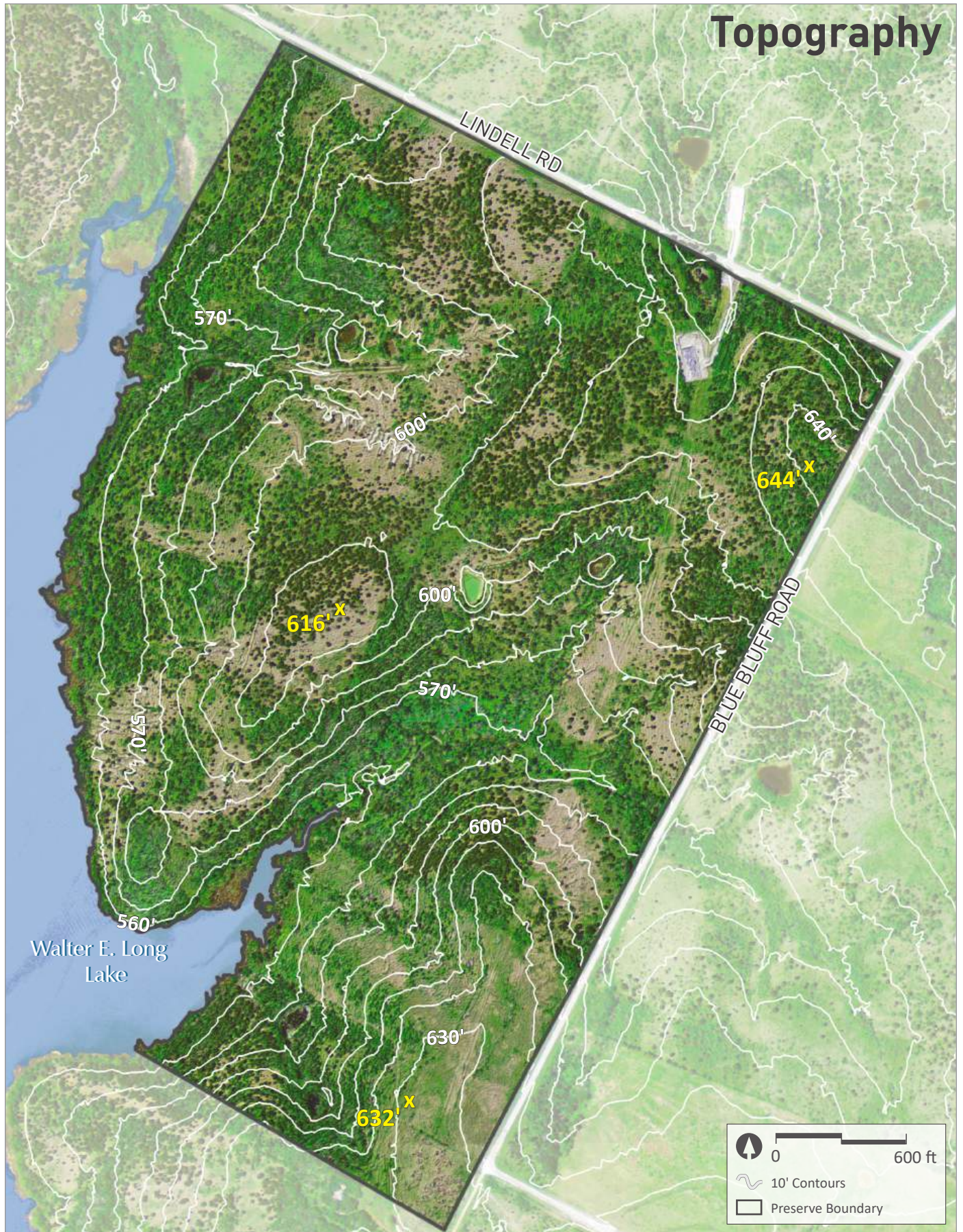


Figure 2.5 Topography.

HYDROLOGY

Walter E. Long Lake is the largest water feature affecting the preserve. At 1,269 acres, it has the capacity to hold more water than Lady Bird Lake and Lake Austin combined.²¹ It was formed in 1967 when Decker Creek was impounded to create a reservoir for the Decker Power Plant.²² The lake is only 53 years old but has already had a significant impact on the ecology of Barrera Wildlife Sanctuary. It has resulted in extensive habitat for aquatic life and has provided enough moisture to sustain distinct plant community classifications, as discussed in the Plant Community section below. The floodplain of Walter E. Long Lake covers 26 acres on the western boundary of the preserve. Its spread inland ranges from 45 ft to 1,172 ft in the mouth of the creek, reaching nearly to the eastern edge of the property (Figure 2.6).

Walter E. Long Lake is part of one of the largest wetland systems in Central Texas.¹⁷ This system includes nine identified wetlands in the Barrera Wildlife Sanctuary, totaling over two acres.²³ These wetlands are comprised of a mixture of ponds and vernal pools that provide valuable water sources and nesting habitat for wildlife. The vegetation surrounding them is distinct from other areas on the property as explained below in the Plant Communities section. There is also a water feature of unknown origin near the pipeline right-of-way. The feature can be described as an open hole in the ground, through which one can see water just a few feet from the soil surface. This water is present year-round. It is unknown whether this is a hand-dug well, but it is currently marked by a wooden post placed there by park rangers.

Several drainages flow generally east to west across the preserve into Walter E. Long Lake. The

Water feature of unknown origin marked by wooden pole.



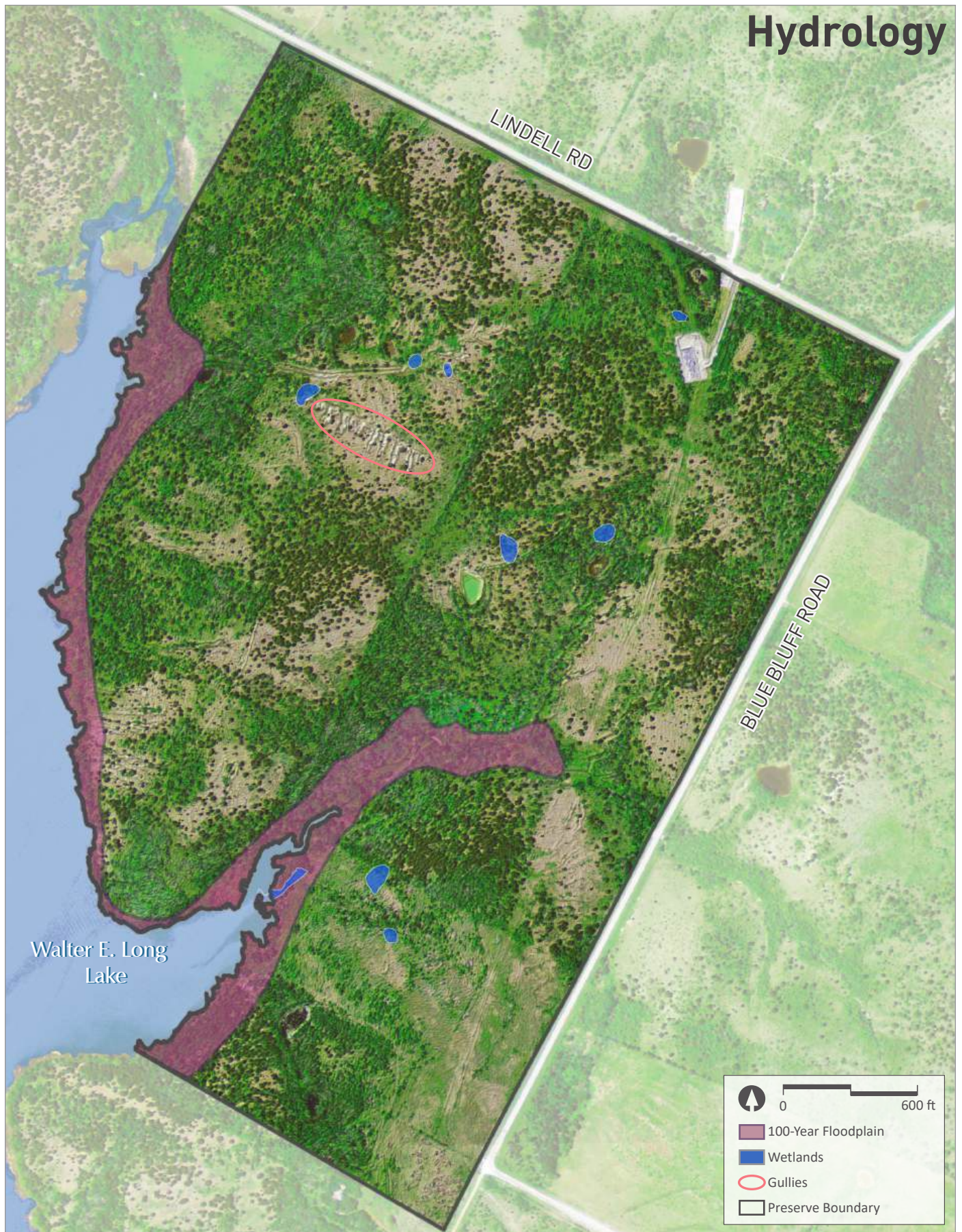


Figure 2.6 Floodplains and wetlands.

largest originates off site and enters the property from the east, flowing through culverts under Blue Bluff Road. Anticipated industrial and residential development north and northeast of the Barrera Wildlife Sanctuary was identified in the Walter E. Long Metro Park Master Plan.¹⁷ Depending on the patterns of this development, the resulting increase in impervious cover could increase runoff to the site, which can have implications for erosion, water quality, and invasive species seed deposition. Therefore, drainages should be monitored closely in the coming years. Recommendations for mitigation actions, should these issues develop in the future, are covered in greater detail in the Natural Area Management Guidelines section.

very hard in the dry season and sticky in the wet season. This may cause heavy machinery to get stuck in wet soils, and makes seed drilling difficult, except for during the short period at the transition between the wet and dry seasons. Additionally, these can also form gilgai, which are shallow microdepressions 1 to several meters across. After heavy rains, these depressions fill with water, reflecting the aboriginal origins of the word, meaning “little water hole.”²⁵ When located on roadways or paths, these gilgai can precipitate erosion if the trail is not located properly (i.e. across the slope as opposed to up and down slopes). No gilgai were located on site, but they are likely present. Vertisols also hold a lot of moisture, which may affect fire behavior via live fuel moisture.

SOIL

There are four soil series found at the Barrera Wildlife Sanctuary, which are subdivided into eight soil types (Figure 2.7 and Table 2.1). These series include Burleson, Ferris, Heiden, and Houston Black. All of these soils are of the Vertisol soil order, which is typical of Texas Blackland Tallgrass Prairies. Vertisols have a high clay content and undergo pronounced changes in volume when wetted. Cracks may open and close periodically, demonstrating soil movement in the profile.²⁴ Because they swell when wet, Vertisols transmit water very slowly and experience little leaching. They also tend to be high in natural fertility.

In relation to management, Vertisols become

Rocky areas in Houston Black Clay.



TABLE 2.1 SOILS

Symbol	Type	Series	Class	Order	Solum Depth	Slope	Texture	% of Site
BtB	Burleson Gravelly Clay	Burleson	Udic Haplusterts	Vertisols	>60 in.	1-3%	clay, silty clay, gravelly clay, clay loam	0.6%
FhF3	Ferris-Heiden Complex	Ferris	Chromic Udic Haplusterts	Vertisols	40 to 60 in	8-20%	clay, silty clay	13.4%
HeC2	Heiden Clay	Heiden	Udic Haplusterts	Vertisols	40 to 65 in	3-5%	clay, silty clay	2.0%
HeD2	Heiden Clay	Heiden	Udic Haplusterts	Vertisols	40 to 65 in	5-8%	clay, silty clay	2.0%
HgF2	Heiden Gravelly Clay	Heiden	Udic Haplusterts	Vertisols	40 to 65 in	8-20%	clay, silty clay	22.7%
HnB	Houston Black Clay	Houston Black	Udic Haplusterts	Vertisols	>80 in	1-3%	clay, silty clay	14.1%
HnC2	Houston Black Clay	Houston Black	Udic Haplusterts	Vertisols	>80 in	3-5%	clay, silty clay	6.8%
HoD2	Houston Black Gravelly Clay	Houston Black	Udic Haplusterts	Vertisols	>80 in	2-8%	clay, silty clay	38.6%

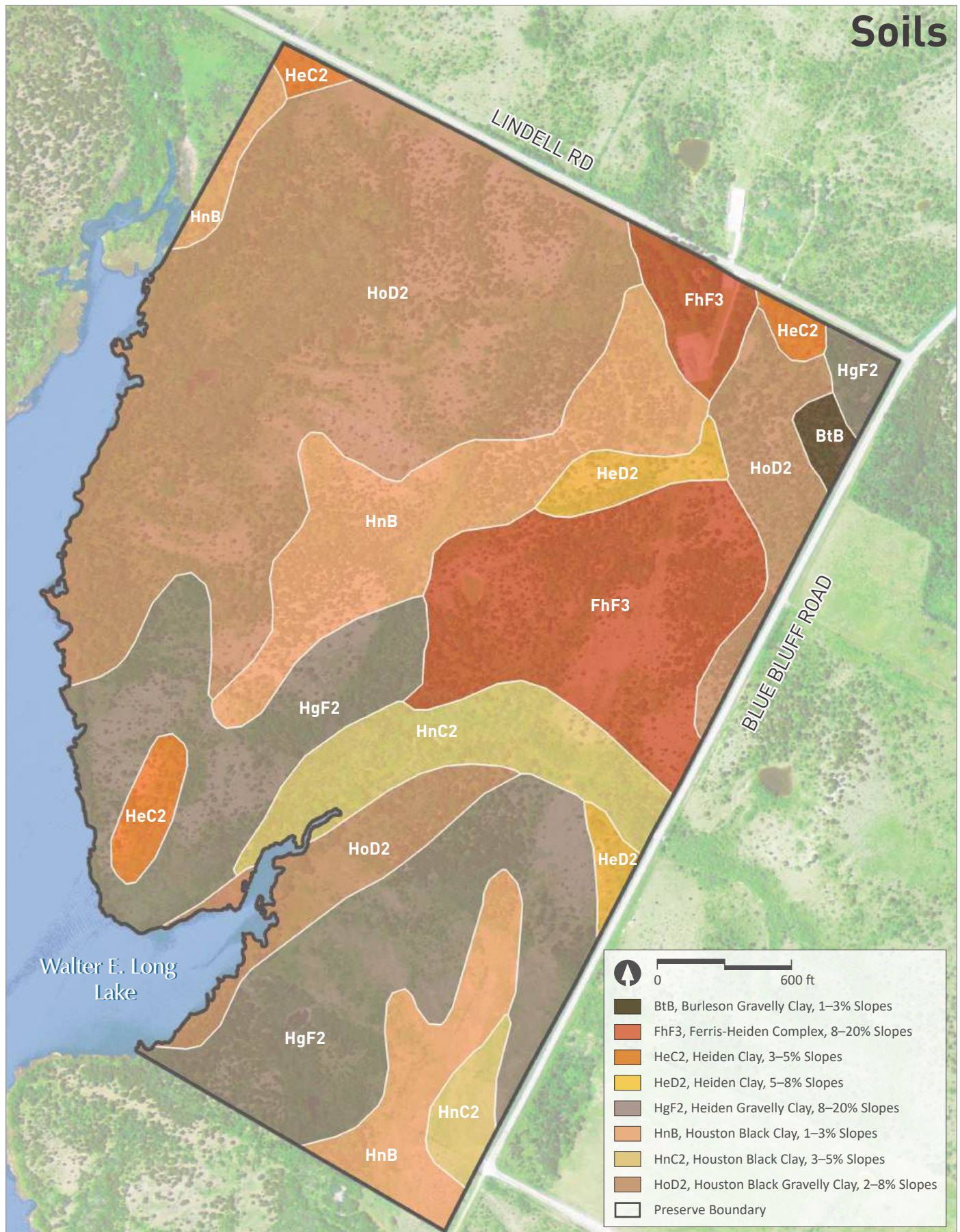


Figure 2.7 Soil types.

They also resist erosion until the soil structure is significantly broken up, at which point soils may wash into the lake. They are generally deep which means they support deep-rooted plants such as honey mesquite.

VEGETATION

BOTANICAL SURVEY

Several plant surveys have been completed over the history of the sanctuary. Plant surveys are an important part of land management, because if well designed and carried out regularly, they can allow land managers to understand the diversity of plant species present, recognize trends over time, and identify rare and invasive species. Plant surveys also allow site managers to identify plant communities, which can inform restoration objectives.

In 2011 and again in 2012, tree, shrub, and herbaceous species were surveyed in 30 plots across the site. In 2014, another vegetation survey and fuel load inventory was conducted by Raven Environmental. Informal vegetation observations have also been recorded for the site using iNaturalist beginning in 2016. Because the site is not open to the general public, many of these observations have been made by PARD staff or by trained volunteers. In 2019, additional observations were made by Siglo Group during 3 site visits. Table 2.2 presents a compiled list of 204 species that have been identified during these surveys. Only iNaturalist observations labeled as “research” quality were included, leaving out observations labeled as “needs ID.” Included in this list are several species of interest, which include netleaf bundleflower, a Texas endemic included on TPWD’s list of Species of Greatest Conservation Need. Additionally, shooting star was found. This species is rare in Central Texas, although it is not given a conservation status due to its large global range.

While the Blackland Prairie ecoregion does not contain many rare plants, it is characterized by a high degree of plant diversity.^{11,26} This ecoregion was historically dominated by perennial tallgrass

species such as little bluestem, big bluestem, and Indiangrass. Iconic Texas wildflowers are also common in the Blackland Prairie, such as Texas bluebonnet, purple coneflower, brown-eyed Susan, and Texas paintbrush. Though characterized by grasslands, the Blackland Prairie is also home to numerous tree and shrub species, especially in riparian areas. These include pecan, black walnut, huisache, eastern red cedar, cedar elm, American beautyberry, buttonbush, fragrant sumac, and autumn sage.²⁶

TABLE 2.2 PLANT SPECIES FOUND AT BARRERA WILDLIFE SANCTUARY

*Plants observed during 2011, 2012, 2014, and 2019 surveys are included in this list. Codes in nativity column: N = native to Texas; N+ = endemic to (found only in) Texas; E = exotic, i.e., not native to Texas. *Species included in 2011, 2012, or 2014 surveys likely due to misidentification, unlikely to be on site.*

	Scientific Name	Common Name	Nativity
Aquatic	<i>Egeria densa</i>	water weed	N
	<i>Heteranthera dubia</i>	water stargrass	N
	<i>Nelumbo lutea</i>	yellow lotus	N
	<i>Potamogeton</i> sp.	pondweed	N
Forb	<i>Abutilon fruticosum</i>	Indian mallow	N
	<i>Acalypha ostryifolia</i>	three-seeded mercury	N
	<i>Agalinis heterophylla</i>	prairie agalinis	N
	<i>Allowissadula holosericea</i>	velvet-leaf mallow	N
	<i>Ambrosia artemisiifolia</i>	common ragweed	N
	<i>Ambrosia psilostachya</i>	western ragweed	N
	<i>Ambrosia trifida</i>	giant ragweed	N
	<i>Amphiachyris dracunculoides</i>	broomweed	N
	<i>Anemone berlandieri</i>	tenpetal anemone	N
	<i>Asclepias asperula</i>	antelope-horn milkweed	N
	<i>Asclepias viridiflora</i>	wand milkweed	N
	<i>Asclepias viridis</i>	green milkweed	N
	<i>Bifora americana</i>	prairie bishop	N
	<i>Brickellia cylindracea</i> *	Brickell-bush	N
	<i>Brickellia eupatorioides</i> var. <i>texana</i>	prairie kuhnna	N
	<i>Calypocarpus vialis</i>	straggler daisy	N
	<i>Cardiospermum halicacabum</i>	balloon-vine	N

TABLE 2.2 PLANT SPECIES FOUND AT BARRERA WILDLIFE SANCTUARY (CONTINUED)

Plants observed during 2011, 2012, 2014, and 2019 surveys are included in this list. Codes in nativity column: N = native to Texas; N+ = endemic to (found only in) Texas; E = exotic, i.e., not native to Texas. *Species included in 2011, 2012, or 2014 surveys likely due to misidentification, unlikely to be on site.

	Scientific Name	Common Name	Nativity
Forb	<i>Centaurea americana</i>	American basket flower	N
	<i>Castilleja indivisa</i>	Texas paintbrush	N
	<i>Chamaecrista fasciculata</i>	Partridge pea	N
	<i>Chamaesyce fendleri</i>	Fendler spurge	N
	<i>Chamaesyce maculata</i>	spotted carpetweed	N
	<i>Chamaesyce serpens</i>	carpetweed	N
	<i>Chloracantha spinosa</i>	Mexican devil-weed	N
	<i>Cirsium texanum</i>	Texas thistle	N
	<i>Cissus trifolia</i>	cow-itch vine	N
	<i>Clematis drummondii</i>	old man's beard	N
	<i>Cnidoscolus texanus</i>	bull nettle	N
	<i>Cocculus carolinus</i>	snailseed	N
	<i>Convolvulus equitans</i>	Texas bindweed	N
	<i>Conyza canadensis</i>	Horseweed	N
	<i>Croton monanthogynus</i>	prairie tea	N
	<i>Cucurbita foetidissima</i>	buffalo gourd	N
	<i>Dalea compacta</i>	purple prairie clover	N
	<i>Dalea enneandra</i>	nine-anther prairieclover	N
	<i>Desmanthus acuminatus</i>	sharp-pod bundleflower	N
	<i>Desmanthus illinoensis</i>	Illinois bundleflower	N
	<i>Desmanthus leptolobus</i>	slenderlobe bundleflower	N
	<i>Desmanthus reticulatus</i>	netleaf bundleflower	N
	<i>Ditaxis humilis</i>	low wild-mercury	N
	<i>Dodecatheon meadia</i>	shooting star	N
	<i>Engelmannia peristenia</i>	Engelmann daisy	N
	<i>Erigeron modestus</i>	prairie fleabane	N
	<i>Erigeron philadelphicus</i>	Philadelphia fleabane	N
	<i>Erigeron strigosus</i>	white top	N
	<i>Eryngium hookeri</i>	Hooker's eryngo	N
	<i>Eryngium leavenworthii</i>	Leavenworth eryngo	N
	<i>Eupatorium serotinum</i>	late boneset	N
	<i>Euphorbia bicolor</i>	snow-on-the-prairie	N
	<i>Euphorbia dentata</i>	toothed spurge	N
	<i>Eustoma exaltatum</i>	bluebell gentian	N
	<i>Gaillardia aestivalis</i>	lanceleaf blanketflower	N
	<i>Gaillardia pulchella</i>	firewheel	N

	Scientific Name	Common Name	Nativity
Forb	<i>Galium aparine</i>	catchweed bedstraw	N
	<i>Galium texense</i>	Texas bedstraw	N
	<i>Glandularia bipinnatifida</i>	prairie verbena	N
	<i>Gutierrezia texana</i>	Texas broomweed	N
	<i>Hedeoma drummondii</i>	mock pennyroyal	N
	<i>Helenium amarum</i>	yellow bitterweed	N
	<i>Helianthus annuus</i>	common sunflower	N
	<i>Helianthus maximiliani</i>	Maximilian sunflower	N
	<i>Heliotropium tenellum</i>	white heliotrope	N
	<i>Hymenopappus scabiosaeus</i>	old plainsman	N
	<i>Ibervillea lindheimeri</i>	balsam-gourd	N
	<i>Indigofera miniata</i>	scarlet pea	N
	<i>Ipomoea cordatotriloba</i>	purple bindweed	N
	<i>Ipomopsis rubra</i>	Standing cypress	N
	<i>Iva annua</i>	sumpweed	E
	<i>Lepidium virginicum</i>	peppergrass	E
	<i>Liatris punctata</i> var. <i>mucronata</i>	gayfeather	N
	<i>Lindheimera texana</i>	Texas star	N
	<i>Linum rigidum</i> var. <i>berlandieri</i>	stiff flax	N
	<i>Ludwigia octovalvis</i>	water primrose	N
	<i>Lupinus texensis</i>	Texas bluebonnet	N
	<i>Lythrum californicum</i>	California loosestrife	N
	<i>Marrubium vulgare</i>	horehound	N
	<i>Matelea reticulata</i>	pearl milkvine	N
	<i>Melilotus indicus</i>	sour clover	N
	<i>Mirabilis linearis</i>	four o'clock	N
	<i>Monarda citriodora</i>	lemon beebalm	N
	<i>Neptunia lutea</i>	yellow puff	N
	<i>Oenothera capillifolia</i>	square bud primrose	N
	<i>Oenothera curtiflora</i>	Gaura	N
	<i>Oenothera laciniata</i>	cut-leaf evening-primrose	N
	<i>Oenothera speciosa</i>	pink evening-primrose	N
	<i>Oxalis dillenii</i>	yellow wood-sorrel	N
	<i>Oxalis drummondii</i>	Drummond wood-sorrel	N
	<i>Penstemon cobaea</i>	fox glove	N

TABLE 2.2 PLANT SPECIES FOUND AT BARRERA WILDLIFE SANCTUARY (CONTINUED)

Plants observed during 2011, 2012, 2014, and 2019 surveys are included in this list. Codes in nativity column: N = native to Texas; N+ = endemic to (found only in) Texas; E = exotic, i.e., not native to Texas. *Species included in 2011, 2012, or 2014 surveys likely due to misidentification, unlikely to be on site.

	Scientific Name	Common Name	Nativity
Forb	<i>Phoradendron tomentosum</i>	mistletoe	N
	<i>Phyla nodiflora</i>	frog fruit	N
	<i>Phyllanthus polygonoides</i>	leaf-flower	N
	<i>Plantago rhodosperma</i>	red-seeded plantain	N
	<i>Pluchea odorata</i>	marsh fleabane	N
	<i>Polytaenia texana</i>	Texas parsley	N
	<i>Pyrrophappus pauciflorus</i>	Texas dandelion	N
	<i>Ranunculus sceleratus</i>	cursed buttercup	N
	<i>Ratibida columnifera</i>	Mexican hat	N
	<i>Rivina humilis</i>	pigeonberry	N
	<i>Rudbeckia hirta</i>	brown-eyed Susan	N
	<i>Ruellia nudiflora</i>	common wild-petunia	N
	<i>Rumex</i> sp.	dock	N
	<i>Salvia farinacea</i>	mealy blue sage	N
	<i>Senecio tampicanus</i>	butterweed	N
	<i>Silphium</i> sp.	Simpson rosinweed	N
	<i>Sisyrinchium scabrum</i>	blue-eyed grass	E
	<i>Solanum dimidiatum</i>	western horsenettle	N
	<i>Solanum elaeagnifolium</i>	silverleaf nightshade	N
	<i>Solidago altissima</i>	tall goldenrod	N
	<i>Stenaria nigricans</i>	bluets	N
	<i>Symphyotrichum divaricatum</i>	Hierba del marrano	N
	<i>Symphyotrichum ericoides</i> var <i>ericoides</i>	heath aster white aster	N
	<i>Tetrameuris scaposa</i>	bitterweed, slender stem	N
	<i>Torilis arvensis</i>	hedge parsley	N
	<i>Tradescantia</i> sp.	spiderwort	N
	<i>Tragia ramosa</i>	noseburn	N
	<i>Verbena halei</i>	Texas vervain	E
	<i>Verbesina virginica</i>	frostweed	E
	<i>Vernonia</i> spp.	ironweed	N
	<i>Vicia ludoviciana</i>	vetch	N
	<i>Warnockia scutellarioides</i>	prairie brazoria	N
	<i>Zephyranthes</i> sp.	rain lily	N

	Scientific Name	Common Name	Nativity
Grass and Grass-like	<i>Andropogon gerardii</i>	big bluestem	N
	<i>Andropogon glomeratus</i>	bushy bluestem	N
	<i>Aristida purpurea</i>	purple threeawn	N
	<i>Arundo donax</i>	Arundo	E
	<i>Bothriochloa ischaemum</i>	King Ranch bluestem	E
	<i>Bothriochloa laguroides</i>	silver bluestem	N
	<i>Bouteloua curtipendula</i>	sideoats grama	N
	<i>Bouteloua dactyloides</i>	buffalo grass	N
	<i>Bouteloua rigidiseta</i>	Texas grama	N
	<i>Bromus arvensis</i>	Japanese brome	E
	<i>Carex microdonta</i>	littletooth sedge	N
	<i>Carex planostachys</i>	cedar sedge	N
	<i>Cynodon dactylon</i>	bermudagrass	E
	<i>Dichanthium sericeum</i>	silky bluestem	E
	<i>Eleocharis montevidensis</i>	sand spikerush	N
	<i>Elymus canadensis</i>	Canada wildrye	N
	<i>Elymus virginicus</i>	Virginia wildrye	N
	<i>Eriochloa sericea</i>	Texas cupgrass	N
	<i>Juncus</i> spp.	rushes	N
	<i>Muhlenbergia lindheimeri</i>	Lindheimer muhly	N
	<i>Nassella leucotricha</i>	Texas wintergrass	N
	<i>Panicum hallii</i>	Hall panicum	N
	<i>Panicum obtusum</i>	vine mesquite	N
	<i>Panicum virgatum</i>	switchgrass	N
	<i>Paspalum dilatatum</i>	dallisgrass	E
	<i>Paspalum distichum</i>	knotgrass	N
	<i>Paspalum pubiflorum</i>	hairyseed paspalum	N
	<i>Paspalum urvillei</i>	Vasey grass	E
	<i>Schizachyrium scoparium</i>	little bluestem	N
	<i>Schoenoplectus californicus</i>	tule	N
	<i>Setaria parviflora</i>	knotroot bristlegass	N
	<i>Setaria viridis</i>	foxtail bristlegass	E
	<i>Sorghastrum nutans</i>	Indiangrass	N
	<i>Sorghum halepense</i>	Johnsongrass	E
	<i>Sporobolus compositus</i>	tall dropseed	N
	<i>Tripsacum dactyloides</i>	eastern gamagrass	N
	<i>Typha</i> spp.	cattail	N

TABLE 2.2 PLANT SPECIES FOUND AT BARRERA WILDLIFE SANCTUARY (CONTINUED)

Plants observed during 2011, 2012, 2014, and 2019 surveys are included in this list. Codes in nativity column: N = native to Texas; N+ = endemic to (found only in) Texas; E = exotic, i.e., not native to Texas. *Species included in 2011, 2012, or 2014 surveys likely due to misidentification, unlikely to be on site.

	Scientific Name	Common Name	Nativity
Tree	<i>Ailanthus altissima</i>	tree of heaven	E
	<i>Celtis laevigata</i>	sugar hackberry	N
	<i>Celtis reticulata</i>	netleaf hackberry	N
	<i>Fraxinus pensylvanica</i>	red ash	N
	<i>Fraxinus pennsylvanica</i>	green ash	E
	<i>Juniperus ashei</i>	Ashe juniper	N
	<i>Juniperus virginiana</i>	eastern red cedar	N
	<i>Maclura pomifera</i>	bois d'arc	N
	<i>Melia azedarach</i>	Chinaberry	E
	<i>Morus alba</i>	white mulberry	E
	<i>Morus rubra</i>	red mulberry	N
	<i>Populus deltoides</i>	eastern cottonwood	N
	<i>Prosopis glandulosa</i>	honey mesquite	N
	<i>Prunus rivularis</i>	creek plum	N
	<i>Rhus sp.</i>	flameleaf sumac	N
	<i>Salix nigra var. nigra</i>	black willow	N
	<i>Sapindus saponaria var. drummondii</i>	western soapberry	N
	<i>Sideroxylon lanuginosum</i>	gum bumelia	N
	<i>Styphnolobium affine</i>	Eve's necklace	N
	<i>Taxodium distichum</i>	bald cypress	N
	<i>Triadica sebifera</i>	Chinese tallow	E
	<i>Ulmus crassifolia</i>	cedar elm	N
	<i>Zanthoxylum hirsutum</i>	prickly ash	N

	Scientific Name	Common Name	Nativity
Shrub	<i>Baccharis neglecta</i>	Roosevelt-weed	N
	<i>Cephalanthus occidentalis</i>	buttonbush	N
	<i>Forestiera pubescens</i>	elbow bush	N
	<i>Ilex decidua</i>	possumhaw	N
	<i>Ilex vomitoria</i>	yaupon	N
	<i>Ligustrum lucidum</i>	Ligustrum	E
	<i>Ligustrum sinense</i>	Chinese privet	E
	<i>Mahonia trifoliolata</i>	agarita	N
	<i>Mimosa sp.</i>	mimosa	N
	<i>Opuntia engelmannii var. lindheimeri</i>	Lindheimer's prickly pear	N
	<i>Parkinsonia aculeata</i>	retama, palo verde	N
	<i>Rhus trilobata</i>	fragrant sumac	N
	<i>Rubus trivialis</i>	southern dewberry	N
	<i>Ziziphus obtusifolia</i>	lotebush	N
Vine	<i>Lonicera japonica</i>	Japanese honeysuckle	E
	<i>Smilax bona-nox</i>	saw greenbriar	N
	<i>Toxicodendron radicans</i>	poison ivy	N
	<i>Vitis monticola*</i>	grape	N
	<i>Vitis mustangensis</i>	mustang grape	N

PLANT COMMUNITIES

Here, the plant communities currently present on the Barrera Wildlife Sanctuary are described and common plant species within each community are listed (Figure 2.8 and Table 2.3). They are informed by the classifications made in the 2014 Raven Environmental Services Report, titled, "Plant Community and Fuel Model Assessment at Indiangrass Wildlife Sanctuary."²⁷ However, all vegetation zones have been updated, with new classifications added and species lists revised in an effort to improve the utility of these classifications for land management purposes. Changes made were based on discussions with City of Austin staff and 2019 field observations made by Siglo Group.

Ashe Juniper Woodland

The Ashe Juniper Woodland is the most abundant plant community on the site, comprising 28% of the landscape. As the name implies, this community is dominated by Ashe juniper, though elbow bush and sugar hackberry are also very common. The community is a mosaic of small patches with canopy cover varying from fully closed woody thickets to sparse areas dominated by grasses and herbaceous species. Of note, netleaf bundleflower, a rare Texas endemic discussed in the Botanical Survey section above, is found in this plant community. King Ranch bluestem is the most pervasive invasive herbaceous species in the more open areas.

Hackberry - Elm Woodland

The Hackberry - Elm Woodland is found on 26% of the site. This area has a relatively closed canopy compared to other areas, though it is still variable, with some areas of sparse to open canopy. It is similar in structure to the Ashe Juniper Woodland, but with greater abundance of cedar elm and sugar hackberry. The most abundant invasive species are Japanese honeysuckle, hedge parsley, and King Ranch bluestem, which is pervasive in open areas.

King Ranch Bluestem Savannah

The King Ranch Bluestem Savanna covers 15% of the site. King Ranch bluestem dominates this vegetation zone, punctuated by scattered groups

of Ashe juniper and other woody species like possumhaw. The canopy in this area has been substantially reduced by mechanical thinning and prescribed burns. It was most recently burned in 2016. Prior to these management activities, the area was a combination of Ashe Juniper Woodland and Hackberry - Elm Woodland. The goal of the management in this area is to transition to Little Bluestem - Indiangrass Grassland (described below), but this will require control of the King Ranch bluestem to allow a diverse array of native prairie species to thrive.

Little Bluestem - Indiangrass Grassland

The Little Bluestem - Indiangrass Grassland comprises 10% of the site. The southeast corner of the site is a particularly good example of this plant community, representing the desired condition for much of the rest of the site. This is an open grassland with limited woody encroachment. Some woody species are still present, but they are scattered individuals or small clumps not forming a dense canopy. Shooting star, a rare species discussed in the Botanical Survey section, was also found. King Ranch bluestem is the most abundant invasive species in these areas.

Historically, much more of the site would have been Little Bluestem - Indiangrass Herbaceous Grassland.



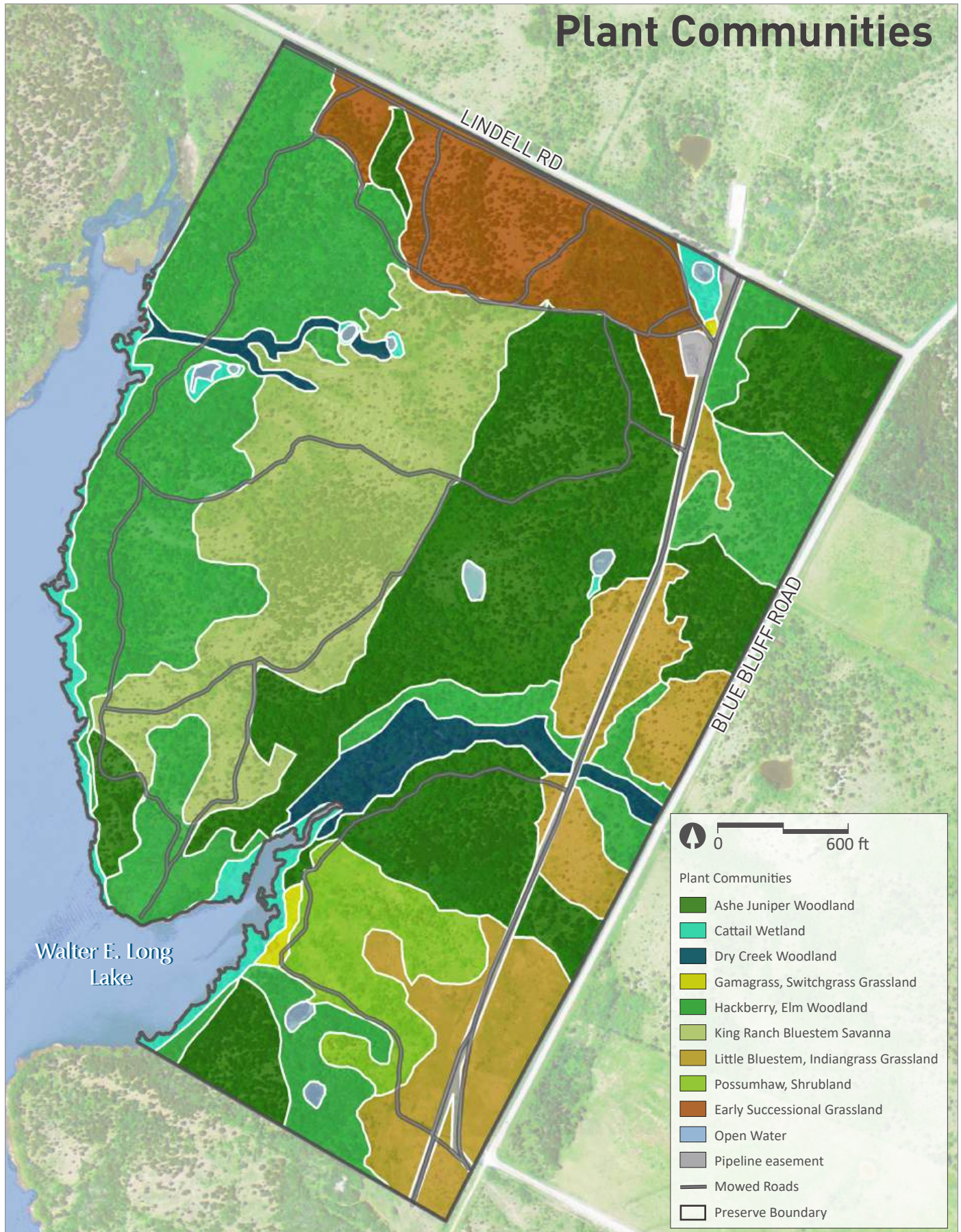


Figure 2.8. Current plant communities.

Early Successional Grassland

The Early Successional Grassland comprises 8% of the site. This woodland plant community is the result of on-going prescribed burns that are actively transitioning areas from woodland to grassland. These transitional areas exhibit characteristics and species of both woodlands and grasslands. With continued management, these areas are expected to transition to Little Bluestem - Indiangrass Grassland.

Possumhaw Shrubland

The Possumhaw Shrubland makes up 4% of the site. It is a dense shrubland predominately dominated by its namesake species. King Ranch bluestem and Japanese honeysuckle are the most abundant invasive species in these areas.

Dry Creek Woodland

Dry Creek Woodland comprises 3% of the site. As the name suggests, this plant community dominates the seasonal creek beds and floodplains of the site. It is believed to have succeeded from low Gamagrass - Switchgrass Grassland due to lack of fire. The canopy is dominated by sugar hackberry

Recently burned Early Successional Grasslands exhibit characteristics of both woodland and grassland.



and the invasive Chinese tallow, but in the most consistently wet areas, black willow, and eastern cottonwood are also present. In addition to Chinese tallow, other common invasive species in these areas are hedge parsley, Japanese honeysuckle, and Johnsongrass.

Cattail Wetland

The Cattail Wetland covers 2% of the site. This plant community occurs along the shoreline of Walter E. Long Lake and the perimeter of ponds and vernal pools. The most saturated wetland areas are dominated by cattail, tule, and sand spikerush. Trees and shrubs line the edges of the wetlands where soils are not as saturated. Invasive species present in these areas include Chinese tallow and Johnsongrass.

Gamagrass - Switchgrass Grassland

The Gamagrass - Switchgrass Grassland comprises <1% of the site. There are two small pockets of this vegetation zone on site, both in particularly low, wet areas. As mentioned above, it is believed that this community would once have been more common on the site when fires were more frequent on the landscape.

Cattail wetlands line the shore of Walter E. Long Lake as well as smaller ponds across the site.



TABLE 2.3 COMMON PLANTS BY PLANT COMMUNITY

Community	Habit	Common Name
Ashe Juniper Woodland	Forb	bluets
		lemon beebalm
		netleaf bundleflower
		prairie brazoria
		sharp-pod bundleflower
	Grass and Grass-like	cedar sedge
		Indiangrass
		King Ranch bluestem
		little bluestem
		littletooth sedge
		silver bluestem
		tall dropseed
		Texas wintergrass
	Tree	Ashe juniper
		cedar elm
		eastern red cedar
		honey mesquite
		sugar hackberry
	Shrub	elbow bush
		povertyweed
Hackberry - Elm Woodland	Forb	broomweed
		hedge parsley
		lemon beebalm
		silverleaf nightshade
		Texas thistle
		western ragweed
	Grass and Grass-like	King Ranch bluestem
		purple threeawn
		Texas wintergrass
		Virginia wildrye
	Tree	Ashe juniper
		bois d'arc
		cedar elm
		eastern red cedar
		green ash
		gum bumelia
		honey mesquite
		sugar hackberry
		western soapberry
	Shrub	elbow bush
		Lindheimer's prickly pear
		southern dewberry
	Vine	Japanese honeysuckle
		mustang grape
		saw greenbriar

Community	Habit	Common Name
King Ranch Bluestem Savanna	Grass and Grass-Like	King Ranch bluestem
	Tree	Ashe juniper
	Shrub	possumhaw
Little Bluestem - Indiangrass Grassland	Forb	lanceleaf blanketflower
		Maximillian sunflower
		prairie bishop
		prairie tea
		slenderlobe bundleflower
		tall goldenrod
	Grass and Grass-Like	Indiangrass
		Little bluestem
		silver bluestem
		big bluestem
	Tree	Ashe juniper
		eastern red cedar
		gum bumelia
		honey mesquite
		sugar hackberry
	Shrub	elbow bush
Early Successional Grassland	Forb	gayfeather
		Maximilian sunflower
	Grass and Grass-like	Indiangrass
		little bluestem
		silver bluestem
	Tree	Ashe juniper
		eastern red cedar
		honey mesquite
	Shrub	possumhaw
		southern dewberry
		yaupon
	Vine	saw greenbriar

TABLE 2.3 COMMON PLANTS BY PLANT COMMUNITY (CONTINUED)

Community	Habit	Common Name
Possumhaw Shrubland	Forb	American basket flower
		gayfeather
		tall goldenrod
	Grass and Grass-Like	big bluestem
		Indiangrass
		King Ranch bluestem
		sideoats grama
		silver bluestem
	Tree	Ashe juniper
		cedar elm
		honey mesquite
	Shrub	southern dewberry
		elbow bush
		possumhaw
		Roosevelt weed
		yaupon
	Vine	Japanese honeysuckle
		saw greenbrier
Dry Creek Woodland	Forb	catchweed bedstraw
		frostweed
		giant ragweed
		hedge parsley
		ironweed
		sumpweed
		tall goldenrod
		Texas bedstraw
	Grass and Grass-like	Canada wildrye
		Indiangrass
		Johnsongrass
		knotroot bristlegrass
		Texas wintergrass
		Virginia wildrye
	Tree	black willow
		cedar elm
		Chinese tallow
		eastern cottonwood
		eastern red cedar
		western soapberry
		sugar hackberry
	Shrub	possumhaw
	Vine	Japanese honeysuckle

Community	Habit	Common Name
Cattail Wetland	Grass and Grass-like	bushy bluestem
		cattail
		rushes
		sand spikerush
		sedges
		tule
	Tree	bald cypress
		black willow
		eastern cottonwood
		green ash
	Shrub	buttonbush
Gamagrass - Switchgrass Grassland	Forb	American basket flower
		Maximilian sunflower
		ironweed
		slenderlobe bundleflower
		sumpweed
		tall goldenrod
	Grass and Grass-like	bushy bluestem
		Canada wildrye
		eastern gamagrass
		foxtail bristlegrass
		Indiangrass
		Lindheimer muhly
		switchgrass
		Virginia wildrye
	Shrub	possumhaw
	Vine	mustang grape
		southern dewberry

WILDLIFE

The Barrera Wildlife Sanctuary supports abundant wildlife, and as native plant communities are restored, the abundance and diversity of wildlife species would be expected to increase.²⁸ Observations dating back to the 1980's mention a wide range of animals such as beaver, eagles, hawks, and nutria visiting the site. These observations, made by PARD staff, were recorded via a combination of handwritten notes and online database entries on eBird and iNaturalist.

The eBird and iNaturalist databases contain 148 bird species observations, collected on this site since 1994. The majority were recorded between 2018-2019.²⁹ Notable rare birds include the American Pipit, Bald Eagle, Baltimore Oriole, Bell's Vireo, Least Flycatcher, Least Grebe, Painted Bunting, Sedge Wren, Vermillion Flycatcher, and White-winged Dove.^{29,30}

In addition to these citizen science efforts, bird species on-site have been more regularly recorded as part of the Project Prairie Bird initiative, which began in Winter 2018. This initiative represents a more focused study of grassland birds and their habitat preferences.³¹ On the preserve, this program has collected data on six grassland bird species including Le Conte's Sparrow, Lincoln's Sparrow, Savannah Sparrow, and Song Sparrow. Populations of tallgrass prairie birds such as these have declined dramatically due to habitat loss, making these efforts to document their nesting preferences and site visitation ever more valuable.³²

THREATS

INVASIVE SPECIES

An invasive species is "an [exotic] species whose introduction does or is likely to cause economic or environmental harm or harm to human health."³³ Their aggressive growth and spread can crowd out and replace native plants, thus disrupting natural processes. However, many plant invasions are facilitated by the disruption of natural processes such as fire, flooding and other natural hydrology,

and plant competition and nutrient cycling. Plant invasions, therefore, at least in the early stages, are often a result of an earlier disruption.^{34,35} Thus, effective invasive species management strategies often include the reintroduction or facilitation of natural processes in addition to removal of the invasive species. The impact of invasive species can be very dramatic and ranks second only to direct habitat destruction as the principal threat to rare species globally, with 49% of imperiled species being negatively impacted.³⁶ The ways invasive plants threaten native communities include:

- Reduction of biodiversity and habitat quality via competition with native species
- Hindrance of reestablishment of native plant and animal species
- Altering soil chemistry

Invasive plants also impact native wildlife by displacing the native flora animals use for shelter, protection, and food. A South Texas study found that overall bird abundance was 32% greater on native-grass sites than on exotic-grass sites.³⁷ In Arizona, bird diversity and richness (number of species) are lower in degraded native plant communities than in non-degraded plant communities.³⁸

There are several possibilities for how invasive plants arrived on site including:

- Planted by previous landowners – Several invasive grasses such as KR Bluestem and Johnsongrass may have been seeded on site for grazing purposes.
- Local recruitment – The seeds of invasive species can also travel to the site from adjacent areas via wind distribution and fruit-eating birds. Chinaberry, Chinese tallow, and Ligustrum all produce abundant fruits that are consumed and distributed by birds.

Some areas of the Barrera Wildlife Sanctuary are dominated by invasive plant species. For example, in the 2011 and 2012 Barrera Wildlife Sanctuary botanical surveys discussed previously in this chapter, King Ranch bluestem, an invasive grass, was present in 53% of plots and represented more than half of the herbaceous cover in approximately 37% of plots. King Ranch bluestem occurs in open areas across the site and is most abundant in

grassy areas with full sun, including those areas that have been burned. As more of the site shifts from woodland to grassland, King Ranch bluestem could become even more problematic if not aggressively managed.

While not as widely spread as the King Ranch bluestem, both Japanese honeysuckle and Chinese tallow are also dominant within some areas of the sanctuary and have the potential to dominate more areas if left unchecked. Chinese tallow occurs along riparian areas, oftentimes surrounded by dense clusters of young individuals. Chinese tallow's ability to produce a substantial amount of seed, as well as the 5-year dormancy period, could allow for a dramatic increase in the number of individuals in the coming years.³⁹

Japanese honeysuckle occurs in the woodlands and shrublands throughout the site. It is not well-established in all parts of the preserve, but there are several very dense infestations where Japanese honeysuckle is the dominant groundcover and is also climbing and covering shrubs and small trees.

In addition to the three species mentioned above, 13 other invasive plant species have been identified on the preserve (Table 2.4). While not yet dominant, these species have the potential for a substantial impact and should be managed and monitored as well. Additional woody invasives identified on the site are Chinaberry and Ligustrum, and additional invasive grasses are Johnsongrass, silky bluestem, Arundo, and Japanese brome.

WOODY SPECIES ENCROACHMENT

In the absence of historic fire regimes and grazing animals, woody species have become abundant, forming woodlands or shrublands across much of the preserve. Although they are native species, Ashe juniper, honey mesquite, gum bumelia, sugar hackberry, cedar elm, and possumhaw are all problematic in areas. As the goal of this site is to restore prairie, woody cover will need to be reduced. Canopy cover in Blackland Prairie is believed to have been less than 10% except along riparian corridors.⁴⁰ Currently, the canopy cover at Barrera Wildlife Sanctuary is estimated at 20% using a normalized difference vegetation index (NDVI) based on 2018 NAIP aerial imagery.

TABLE 2.4 INVASIVE PLANTS

Common Name	Habit
Arundo	Grass
Bermudagrass	Grass
Dallisgrass	Grass
Japanese Brome	Grass
Johnsongrass	Grass
King Ranch Bluestem	Grass
Silky Bluestem	Grass
Vasey Grass	Grass
Hedge Parsley	Herbaceous
Chinese Privet	Shrub
Ligustrum	Shrub
Chinaberry	Tree
Chinese Tallow	Tree
Tree of Heaven	Tree
White Mulberry	Tree
Japanese Honeysuckle	Vine

EROSION & SOIL DISTURBANCE

Some minor erosion issues were found along drainage areas during site visits by Siglo Group. Though these issues are not currently of great concern, soil disturbance and erosion could become a larger issue in the future, especially as user access to the site changes and increased water flows travel through the site from nearby developments. The Natural Area Management Guidelines section includes recommendations for how to prevent erosion issues in the future.

TRAMPLING

No trampling, informal trails, or other site degradation caused by pedestrian foot traffic have been observed on the site. However, pedestrian traffic may result in trampling in the future. If issues develop once the public is able to visit the Barrera Wildlife Sanctuary property, consult the Natural Area Management Guidelines section for mitigation recommendations.

PART 3:

Natural Area Management

- 30 Past Land Management Practices
- 30 Adaptive Management & Process Approach
- 30 Mechanical Brush Management
- 33 Fire Regime
- 34 Invasive Species Management
- 34 Seeding & Planting to Increase Biodiversity
- 37 Mitigating Soil Disturbance & Erosion
- 38 User Experience

Woody vegetation clearing to prepare for prescribed burns at BWS.

The management guidelines presented here were created in response to articulated needs of City staff, a compilation of Siglo Group's observations, previous plans and reports, and the 53-year management history of the site to develop a cohesive management plan for the sanctuary. The guidelines update and build upon the 2011 Austin Parks and Recreation Department (PARD) Management Plan and the 2014 Raven Environmental Services Report.^{10,27} The following management practices are based on recommendations by City of Austin land managers and Siglo Group.

PAST LAND MANAGEMENT PRACTICES

Reviewing land management history is key to understanding the ways that a site has been altered, while learning from past successes and challenges. Records of land management practices at Barrera Wildlife Sanctuary have spanned from its acquisition to present day (Figure 3.1). Though the history of land management on the site stretches back to the 1960s, the majority of the actions have taken place since 2011, and not all actions have been recorded in detail. Management units are suggested to aid in the description of past management activities as well as give recommendations for future management (Figure 3.2).

During the 1990s, one prescribed burn and several seedings took place. The specific management units where these occurred and the species content of the seed mixture is unknown, but these were presumably species typical of the Blackland Prairie. Since 2011, more restoration activities have taken place on the site. Records indicate that prescribed burns were carried out in 2012, 2014, 2016, 2018, and 2019. The areas burned in 2012 are not known. In 2014, management units B and J were burned, though parts of the densely wooded northern section of B and western section of J did not burn. In 2016, A7 and A8 were burned. In 2018, A1-4 along with C1-3, E, F, and H were burned. A1-4 was burned again in 2019 (Figure 3.2). Additionally, mechanical thinning of woody

vegetation was recorded during 2014 and, based on communication with PARD and Fire Department staff, continues to frequently occur in various areas of the site to prepare for future burns, though a detailed record of where and when thinning has occurred is not available.

ADAPTIVE MANAGEMENT & PROCESS APPROACH

Ecological restoration requires multiple treatments over many years. In addition, ecosystems respond differently to management practices according to environmental and climatic factors. Adaptive management is the process by which managers adjust methods in response to analysis of monitoring data, as well as changing environmental contexts and resource availability. As these management actions are implemented, outcomes should be tracked, and management practices adjusted to ensure future effectiveness. It is recommended that at major decision points, previous management data be reviewed and considered to determine effective next steps. In the following chapter, the management actions described in this section will be applied to the management units to provide a task-oriented roadmap for prairie restoration.

MECHANICAL BRUSH MANAGEMENT

Woody vegetation must often be removed or thinned mechanically either to prepare for prescribed burning or because the vegetation cannot be managed by other means. Trees can be cut individually with chainsaws or equipment implements such as tree shears. Where brush is dense and small in diameter, or when cutting single trees is not practical or economical, brush can be shredded with implements such as forestry mowers. Neither *Juniperus* species on site resprout after being cut or fully top-killed, so mechanical means alone are effective for control. However, all other problematic woody species on site, such as honey mesquite and invasive woody

Timeline



Figure 3.1. Timeline of past, current, and planned land management at Barrera Wildlife Sanctuary.

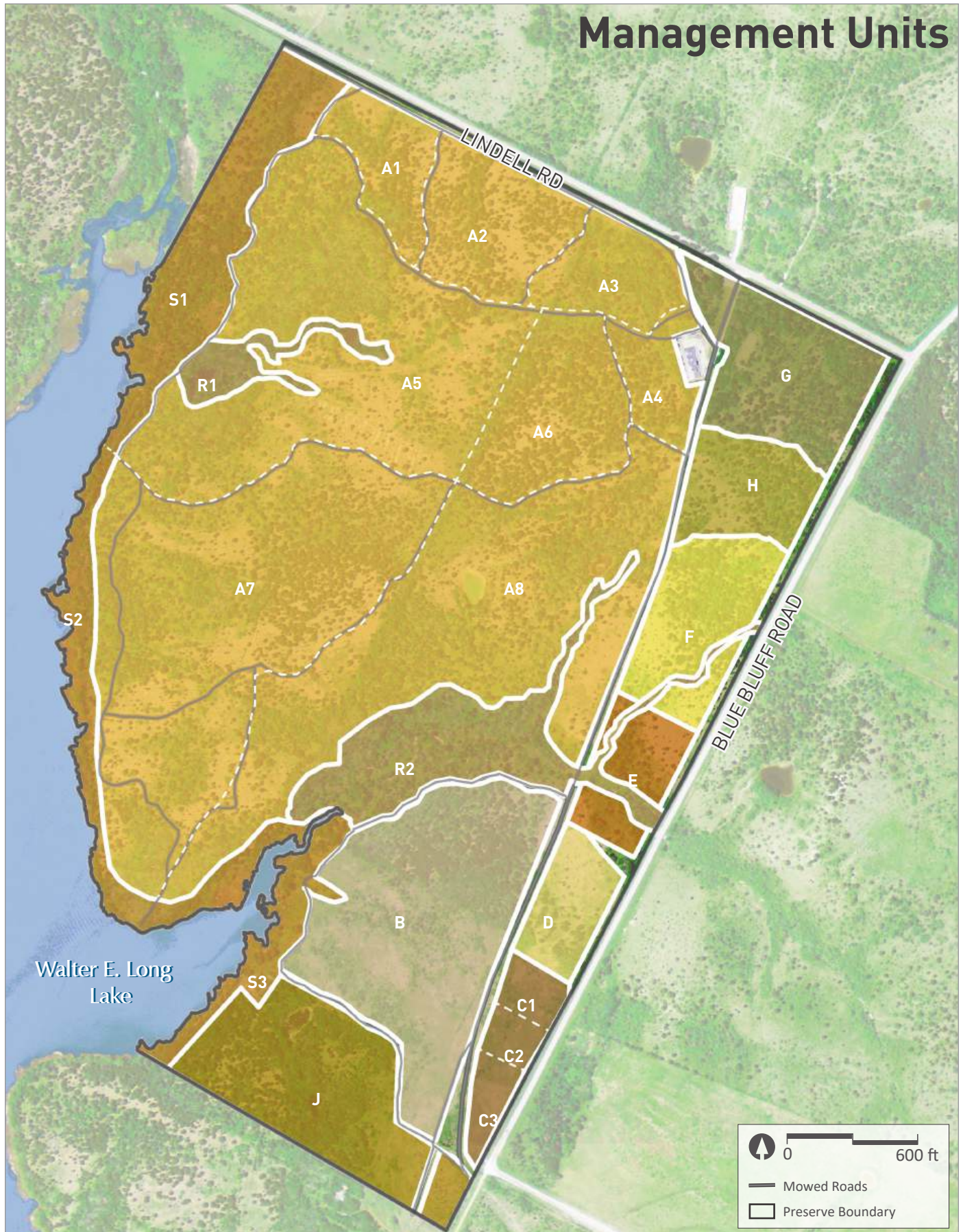


Figure 3.2. Management units.

species, resprout vigorously after top removal and may need to be treated either through prescribed burns or with herbicide to be effectively controlled.

When small diameter mixed brush is shredded, follow-up herbicide is often impractical. In this situation, follow the shredding treatment with prescribed fire. After fine fuels have sufficiently recovered — but before woody resprouts become too tall to be top-killed with fire — is a workable strategy. At this point, maintaining fire or mowing treatments on a frequency short enough to keep resprouting brush suppressed is critical.

Heavy equipment should be operated in ways that minimize soil disturbance. Operating equipment on wet soil can cause compaction and should be avoided. Minimizing equipment traffic over the same ground is also important for minimizing compaction.

Skid steers are relatively light equipment and typically do not cause compaction of dry soil. However, because skid steer wheels or tracks do not articulate, the wheels or tracks “skid” across the ground when the machine turns. Thus, damage to herbaceous vegetation can be caused when operators make tight turns. So, land managers must work with skid steer operators to ensure they make wide arc turns. Larger equipment such as articulated loaders are heavier and are often perceived as having greater potential to cause more compaction on soft or wet soils. These machines, however, have larger tires which results in less pressure per unit area applied to the ground. The tires of these machines also articulate, so little damage to herbaceous vegetation is caused during turning. In the end, damage to soils and vegetation ultimately depends on the technique of the operator. Beyond this, selection of equipment for brush control may depend on available clearance under the limbs of desirable trees as well as cost per unit of work accomplished.

Brush control techniques, such as dozing and chaining, that push rather than cut or shred are not recommended due to the inordinate degree of soil disturbance they can cause. Whereas dense native herbaceous vegetation can recover in a single growing season following tree cutting or brush shredding, several growing seasons are

often required for recovery following dozing or chaining, during which time invasive species often reestablish.

FIRE REGIME

Prescribed fire is the keystone management tool recommended for restoring Blackland Prairie. Fire is not the only strategy available at the preserve, but it is, in many ways, the one that makes all the other strategies work. Without fire or some kind of intensive rotational grazing regime as an option, grassland restoration by purely mechanical or chemical means can become cost prohibitive at even small scales and often not fully effective.

First-order effects of effective prescribed burns are the removal of most herbaceous material and top-kill of small woody plants. Second-order effects are stimulated growth and seed production of many perennial herbaceous species, germination and establishment of annual species, and mortality of top-killed non-resprouting woody species and of some proportion of even resprouting woody species, especially if individuals are still recovering aboveground material from a previous top-kill event (such as cutting or prior fire).

Second-order effects are also influenced by the seasonality of the fire. Establishment and growth of cool season herbaceous species, including most annuals—the majority of which germinate in the late fall, winter, and early spring—is often increased more by a summer burn than a winter burn. Conversely, growth and seed production of warm season species, including most perennial native grasses, are often stimulated more by winter fire than summer fire. In fact, summer fires tend to favor all forbs (perennial and annual).⁴¹

For woody species, top-kill is influenced predominately by fire intensity and live fuel moisture. Fire intensity is, on average, higher during the summer. However, the weather, climate, fuels, and vegetation conditions that affect fire intensity are highly variable.⁴² Once top-killed, mortality of resprouting woody species is often higher after summer fire (especially if still recovering from a previous top-kill event), presumably because more plant resources are

allocated aboveground during the growing season.

Evidence shows that warm-season (early to mid-summer) burns are a cost-effective tool for controlling King Ranch bluestem, while having little to no effect on most native grasses.^{43,44} King Ranch bluestem plants are susceptible to summer burns, but recruitment from seed can reestablish pre-burn cover within 3 years.^{10,45,46} Competition from seeded native herbaceous species may be able to reduce King Ranch bluestem recovery post-burn. Successive burns at a 2-3-year return interval may also further reduce King Ranch bluestem cover.

INVASIVE SPECIES MANAGEMENT

There are 16 invasive plant species found on site (Table 2.4). According to the City of Austin Invasive Species Management Plan, the species with a highest rating for severe ecological impact are *Arundo*, *Ligustrum*, *Chinaberry*, and *Johnsongrass*. Those with a moderate ranking include Japanese honeysuckle and Chinese tallow.⁴⁷ While King Ranch bluestem has an unknown ranking, Siglo Group observations have noted that this species is by far the most dominant invasive on the site. Furthermore, according to observations and due to their prevalence on the preserve, the invasive plants causing the largest impact or with potential for a substantial impact are King Ranch bluestem, Japanese honeysuckle, and Chinese tallow.

The primary treatment recommended for King Ranch bluestem is warm season burning. Fire may also be effective for managing Japanese honeysuckle.⁴⁸ However, it resprouts vigorously after disturbance, so repeated burns would likely be needed in order to effectively control it.

Some invasive species may require mechanical removal or chemical treatment due to their position in wetland or riparian area that is not burned, a need for immediate treatment between burn cycles, and/or survival from a prior burning. For example, fire is unlikely to be effective in managing Chinese tallow,⁴⁹ especially due to its location primarily in the wettest areas of the site.

Pest controls which are effective, affordable, and present negligible risk to people, property, or the environment are considered first. These typically include cultural and certain mechanical control methods. However, individual treatment of plants with herbicide is sometimes required. Pesticides should only be applied in a way that minimizes potential harm to people, property, and the environment.

Follow-up treatments are often needed to achieve full control. Long-term invasion resistance often requires robust interspecies competition within the native plant community. Dense native prairie plants can reduce bare ground available for colonization by invasive species.

The large patch of *Arundo* in the northwest corner of the site is part of ongoing tests using parasitic wasps as a potential biocontrol of *Arundo*. Therefore, communication with appropriate City staff is needed in order to decide if, when, and how this patch should be removed.

SEEDING & PLANTING TO INCREASE BIODIVERSITY

Planting and seeding may be needed in many areas to improve diversity and abundance of native species. Perennial forbs and grasses can be established upon the removal of King Ranch bluestem and other undesirable species in open areas. Seed mixes should also include native milkweed for Monarch Butterflies and native wildflowers for all pollinators. To attract more grassland bird species, prairie seed mixes with switchgrass and big bluestem create food sources for grassland bird species such as Grasshopper Sparrow and Le Conte's Sparrow. A recommended prairie species list is included in Table 3.1

SEEDING

Seeding is an integral part of prairie establishment and should follow prescribed burns, invasive species removal, and brush removal whenever it is anticipated that full herbaceous coverage may not recover within one growing season. Seeds can be planted by use of a seed drill, which has yielded good results in landscape-scale restoration

projects on Water Quality Protection Lands, or can be hand-seeded, seeded and raked, or broadcast. As with all practices, seeding should be overseen by a trained professional or volunteer with a focus on seed bed preparation and ensuring that competition from woody and weedy species does not undermine the seeding efforts.⁵⁰

Restoration is an ongoing process, so seeding some areas as “seed islands” may be appropriate. A seed island is an area that has been planted or seeded in anticipation of the species spreading to surrounding areas. The seed island can be quite small (as small as 8 feet by 8 feet). The area should have invasive species removed and controlled until full coverage of native plants is established. After preparation, the area should be seeded and/or

planted. The seed island concept can be used in any of the management units.

LIVE PLANTINGS

Live plantings tend to reach maturity faster, provide more native ground coverage, and can ensure establishment of particularly difficult-to-establish species. Variables that help decide whether live planting is cost effective on site include the presence of high soil moisture for transplant establishment, whether invasive species and canopy coverage will inhibit seeding, cost of labor and resources for planting and management during establishment, and whether natural recovery is a realistic option. On Barrera Wildlife Sanctuary, live plantings will likely only be feasible in the moist soils of riparian areas, where prescribed burns are

TABLE 3.1 RECOMMENDED PRAIRIE SPECIES LIST FOR BARRERA WILDLIFE SANCTUARY

Common Name	Scientific Name	Light Requirement	Bloom Time	Moisture Requirement
Big Bluestem	<i>Andropogon gerardii</i>	Sun/Part Shade	Fall	Moist
Eastern Gamagrass	<i>Tripsacum dactyloides</i>	Part Shade	Spring	Moist
Indiangrass	<i>Sorghastrum nutans</i>	Sun	Fall	Moist-Wet
Little Bluestem	<i>Schizachyrium scoparium</i>	Sun	Fall	Dry
Sideoats Grama	<i>Bouteloua curtipendula</i>	Sun/Part Shade	Fall	Dry-Moist
Switchgrass	<i>Panicum virgatum</i>	Sun/Part Shade	Fall	Dry-Wet
Tall Dropseed	<i>Sporobolus compositus</i>	Sun	Fall	Moist
Black-eyed Susan	<i>Rudbeckia hirta</i>	Sun/Part Shade	Summer	Dry-Moist
Cutleaf Daisy	<i>Engelmannia peristenia</i>	Sun/Part Shade	Spring-Summer	Moist
Purple Coneflower	<i>Echinacea purpurea</i>	Sun/Part Shade	Spring-Summer	Dry
Huisache Daisy	<i>Amblyolepsis setigera</i>	Part Shade	Spring	Dry
Lanceleaf Coreopsis	<i>Coreopsis lanceolata</i>	Sun/Part Shade	Spring-Summer	Dry-Moist
Prairie Liatris	<i>Liatris pycnostachya</i>	Sun	Fall-Early Winter	Dry-Moist
Showy Evening Primrose	<i>Oenothera speciosa</i>	Sun	Winter-Summer	Dry-Moist
Texas Bluebonnet	<i>Lupinus texensis</i>	Sun	Spring	Dry
Winecup	<i>Callirhoe involucrata</i>	Sun/Part Shade	Spring-Summer	Dry-Moist
Yarrow	<i>Achillea</i> spp.	Sun/Part Shade	Spring-Summer	Dry-Moist
Canada Goldenrod	<i>Solidago canadensis</i>	Sun/Part Shade	Fall	Dry-Moist
Maximillian Sunflower	<i>Helianthus maximiliani</i>	Sun	Fall	Dry-Moist
Mealy Blue Sage	<i>Salvia farinacea</i>	Sun	Spring-Summer	Dry
Tropical Sage	<i>Salvia coccinea</i>	Sun/Part Shade	Spring-Fall	Dry-Moist

not practical, and where brush clearing will leave open gaps in the shrub layer.

Live plantings can consist of trees, shrubs, herbaceous plants, or any combination of the three. While on this site, we do not foresee a need for live plantings. If additional diversity is needed in the woody areas, live plantings of trees or shrubs could be utilized.

SEEDING AND PLANTING GUIDELINES

In all cases, the following guidelines are critical:

- **Prepare for success:** Ensure that trained individuals are part of all seeding and planting activities, make sure the area is prepared for seeding or planting and any degradation issues have been managed (such as invasive species, erosion, or soil compaction).
- **Soil preparation:** Ensure good seed to soil contact. In large areas where seeding is to occur, soil can be disturbed, ideally without harming other desirable plants that are growing in the area. Where feasible, the addition of weed-free organic material in the seed bed can help hold moisture and support new seedlings with nutrients.
- **Use proper seeding rates:** These will vary based on species, whether the seeding is adding diversity to an area with existing vegetation or establishing vegetation in an area prepped specifically for seeding.⁴⁹ Look to your manufacturer or previous experience for specific seeding rates. Seeds can be distributed through broadcast seeding, seed drill, or push behind spreader.
- **Plant or seed at the right time of year:** For seeding, cool season grasses and spring wildflowers should be sown in the fall, while warm season grasses and fall wildflowers may be sown in late winter. Most planting should occur between October and February to allow for establishment before the summer.
- **Plant the right species in the right place:** The recommended plant list found in Table 3.1 includes appropriate locations for each species. Beyond the distinctions in the recommended plant list, an experienced professional and/or volunteer should facilitate decisions about where particular plants are placed. When planting trees in a natural setting, it is also important to use a naturalistic planting design. Planting trees in clumps rather than spacing them evenly will create a more natural aesthetic. Keep in mind that some species may be appropriate for a variety of settings.
- **Plant size:** Due to the lack of supplemental irrigation water on Barrera Wildlife Sanctuary, small caliper plants will have the highest likelihood of survival. Therefore, plants should be the smallest size suitable for the circumstances. Additionally, planting small caliper and bareroot trees allows resources to go much farther because the plant material and installation costs are substantially reduced. That said, in areas where trampling or aesthetics are of immediate concern, larger plants may be appropriate.
- **Irrigation:** It is assumed that irrigation for large areas is not feasible on the site. This means that the expectation of mortality of seeded areas is greater. With normal rain events, seeds should be able to survive, as well as small plants that are planted in the appropriate place. That said, where irrigation is available, it can substantially boost survivability rates during plant establishment. For plantings, temporary irrigation for transplants during the summer months is critical in the first two to three years of establishment after planting. Creative, cost-effective means of irrigating plants (such as through the use of gator bags) will substantially increase plant survivability.
- **Continued care:** Whether trees, understory, or groundcover, seeding or planting is only the first step. Management of invasive species and erosion is critical to restoration success. If the preserve is opened to the public in the future, newly seeded or planted areas near trails should be fenced off to reduce the risk of trampling. Basic interpretation should accompany seeding so visitors can know that the current condition is intentional.

MITIGATING SOIL DISTURBANCE & EROSION

Healthy soils are the foundation of a healthy natural area. As discussed in the Site Analysis, human actions, infrastructure, and stream inflows can have a great impact on the site's ability to support stable soils and healthy plant communities. Although erosion issues are not currently a major problem on the site, they should be monitored as use of the site changes and development occurs in the surrounding area. The recommendations here focus on techniques to alleviate soil disturbance and erosion within the bounds of the sanctuary should they become problematic. The major issues addressed here include sheet, rill, gully, trail, lakeshore, and creek bank erosion. The solutions include green infrastructure, redirection of storm water, regrading, soil amendments, soil decompaction, and infrastructure modification.

SHEET EROSION

Robust native perennial grass cover should be sufficient to eliminate sheet erosion on natural slopes. Grading changes or stormflow diversion may be necessary to reduce run-off from park infrastructure or adjacent impervious cover.

RILL EROSION

As with sheet erosion, upslope solutions to reduce run-off from impervious cover should be considered first for rill erosion. Where upslope solutions are not feasible, or where additional solutions are needed, aggressive replanting may be necessary to reestablish dense herbaceous cover. Installing erosion mats will temporarily hold the soil until the new plants are firmly established.

GULLY EROSION

Gully plugs can be used for larger gullies. These gully plugs consist of a dam at various points along the gully that slows run-off water velocities during high rainfall events long enough for the sediment to drop out and eventually fill the gully.⁵² For gullies that are caused by culvert discharges onto steep slopes, upslope solutions are preferred. In these areas, water-dispersing armoring should be installed where feasible. A variety of materials

may be used to disperse the water, including riprap, concrete, loose stones, and limestone block gabions. Native rock is the preferred material.

TRAIL EROSION

In general, trails should have no more than a 5% slope.⁵³ Where there is a slope on a trail, grade reversals should be planned into the trail alignment to allow water to flow off the trail and back into the natural environment. Ideally this is done regularly enough that there is not a concentration of flow that can lead to rill or gully erosion. That said, in some cases enough concentration of water will result in the need for hardening the exit of water off the trail—with gravel, rocks, or equivalent material. These materials can also be placed to diffuse water as it flows across the landscape. Water bars and steps can be used to shunt water off the trail as well. Additionally, due to the topography of the property, these trails may cross several main drainages of the site. With the anticipated increase in water flow that will pass through these drainages as development occurs off site,¹⁷ these areas will need to be watched closely for washout.

LAKESHORE EROSION

Currently, no erosion problems have been identified on the shoreline of Walter E. Long Lake. If erosion develops in the future, shoreline trees can be used to provide stability. For areas where erosion is found, stabilize eroding banks with erosion control fabric and plant additional trees and herbaceous material.

CREEK BANK EROSION

The creek bed shows bank drawdown of zero to greater than two feet from the eastern boundary of the site until it joins the lake. Downed woody material of significant size can be used to create check dams reduce water velocity, allow for sediments to fall out, and slowly aggrade the channel. These dams can be placed periodically along the stream length to just below the bank erosion point. The addition of these dams will result in a more dynamic stream bed with variable water velocity, creating more diverse habitat for plants and wildlife.

USER EXPERIENCE

TRAIL PLANNING

According to the Water E. Long Metropolitan Park Master Plan, one loop trail is planned to cross the preserve, following the shoreline and several other pedestrian paths that traverse the three highest elevation points of the property (Appendix 2).¹⁷ If these paths are to be implemented in the way they are presented, the considerations laid out in the Trail Erosion section above can help ensure that they do not cause unnecessary issues.

INFORMAL TRAILS

With all trail systems, there is the possibility of informal trails developing. Informal trails are unauthorized trails or paths caused or created by users accessing areas, especially points of interest, that are inaccessible by the formal, or authorized, trail system. These informal trails can cause erosion and damage to vegetation. Unauthorized trails can make it difficult to regulate site access when conducting land management activities—such as prescribed fire, herbicide, heavy equipment operation—that may be dangerous to the public. Lastly, informal trails may convey a message of neglect, which can facilitate more informal trails and other damaging activities such as vandalism, looting, dumping, encroachments, and encampments.

Informal trails can be discouraged by:

- relocating authorized trails farther away from sensitive features
- creating more sustainable authorized trails to points of interest
- placing—and maintaining—clear directional and interpretive signage along authorized trails
- engaging with private user groups to encourage self-policing
- regularly patrolling trails to maintain an on-site presence and enforce other site and trail rules
- directing access to designated access points and preventing access via other locations

- quickly closing and remediating informal trails as they form

Informal trails can be “closed” by covering them with brush. However, the location of the informal trail remains obvious. Often, either the brush is removed, and the trail reestablished, or a new trail is created adjacent to the old trail. Informal trails are more reliably closed by full remediation of at least the portions that are visible from the authorized trail. This involves filling degraded trail tread up to grade, covering with leaf litter and other debris, and replanting if necessary. Signage interpreting the site as a “restoration area” may be effective. Obstacles such as cables or large brush can be placed on or across the old trail, out of sight of the authorized trail, to discourage reopening or reuse of the remediated informal trail.

WATER ACCESS

There are no formal water access points within the Barrera Wildlife Sanctuary designated in the Walter E. Long Metropolitan Park Master Plan.¹⁷ To protect riparian areas, the installation of formal water access points should be considered. Park users often try to access the shoreline regardless of whether there is a formal access point, which can lead to trampling, erosion, and damage to shoreline vegetation. Formal access points should be clearly connected to a formal trail, have appropriate amounts of space to accommodate users, and have sufficient infrastructure to support appropriate activities such as sitting, fishing, or bird watching. In addition to accommodating user needs, these sites must be stabilized to resist erosion from flooding and foot traffic.

PART 4:

Moving Forward

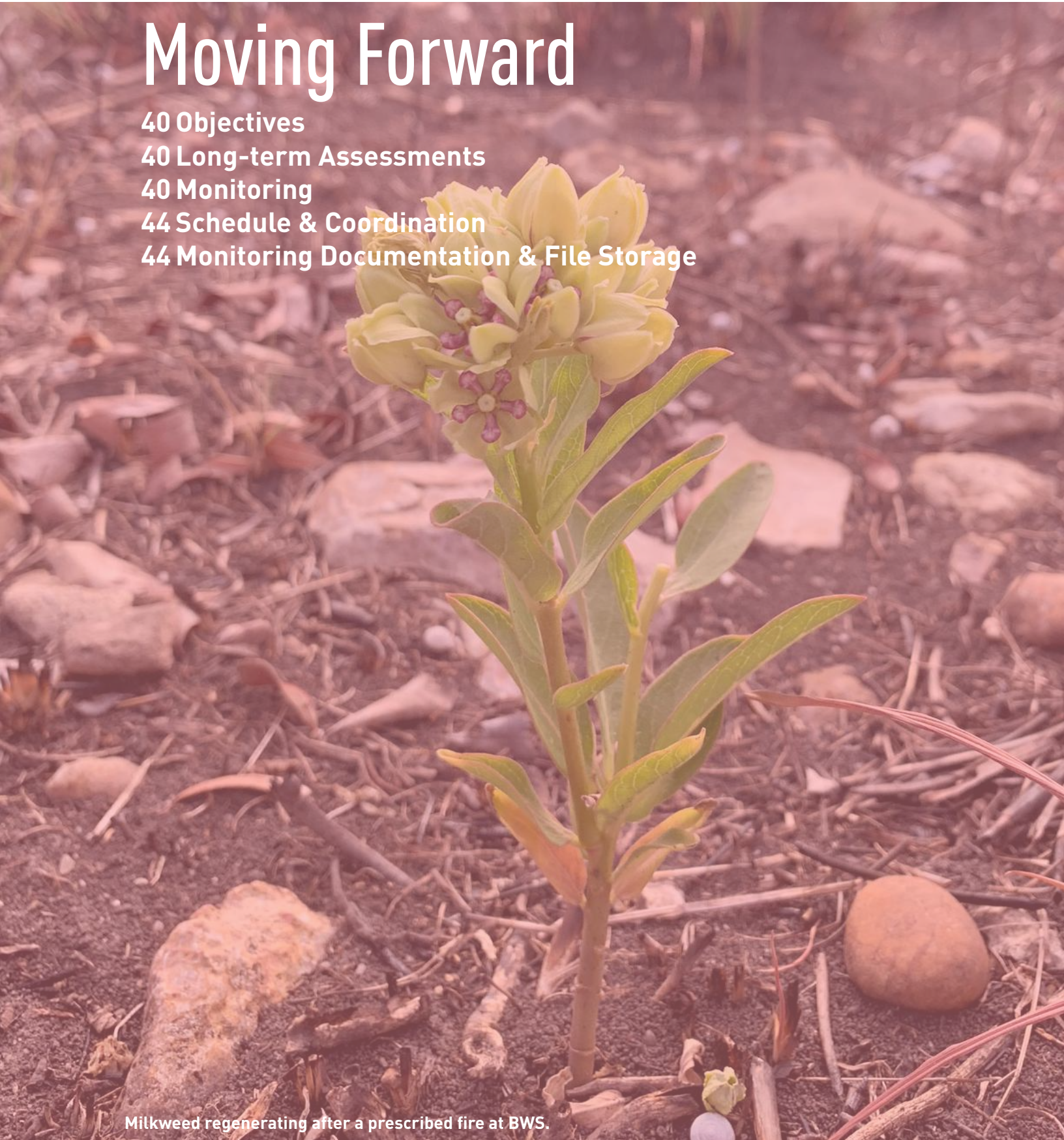
40 Objectives

40 Long-term Assessments

40 Monitoring

44 Schedule & Coordination

44 Monitoring Documentation & File Storage



Milkweed regenerating after a prescribed fire at BWS.

To restore the plant communities and wildlife habitat of Barrera Wildlife Sanctuary, active management will be necessary in the coming years. The Moving Forward section builds upon the guidelines and concepts introduced in the previous chapters, with a focus on the practical elements needed to complete tasks. Topics include:

- Objectives – Suggested objectives to drive restoration
- Long-term Assessments – A description of the surveys needed to support restoration work in the coming years. Monitoring – Suggested annual monitoring protocols
- Schedule & Coordination – A land management schedule that prioritizes tasks by natural area management zone
- Documentation – A suggested documentation protocol

OBJECTIVES

An objective is a concise statement that helps to define success. Objectives derive from goals and provide the basis for determining strategies, monitoring, accomplishments, and evaluating the success of strategies. When possible, objectives should be formulated to be “SMART”: Specific, Measurable, Achievable, Realistic, and Time-bound.

The management goal for Barrera Wildlife Sanctuary is to restore the site primarily to Blackland Prairie. The Southern Blackland Ecological Site Description for this ecoregion specifies two characteristic communities: Tallgrass Prairie Community and Midgrass Prairie Community. Major tallgrass species include little bluestem, Indiangrass, big bluestem, switchgrass, and eastern gamagrass. Common midgrass species include buffalograss, tall dropseed, and knotwood bristlegrass.

The following objectives were developed based on these descriptions:

- Maintain canopy cover of less than 35% within midgrass community and transitions to less than 10% canopy cover in the large patches of tallgrass grassland.

- Cultivate healthy plant communities that are dominated by native, warm-season, perennial tallgrasses and midgrasses.
 - Most common species include Indiangrass, big bluestem, little bluestem, prairie wild-rye, sideoats grama, silver bluestem, Texas wintergrass, Texas cupgrass, and eastern gamagrass.
 - Measures may include:
 - Annual production is greater than 50% of total annual net primary productivity (ANPP)
 - Aerial cover is greater than 75%
 - Frequency of occurrence is greater than 50%
- Ensure native forbs remain sub-dominant.
 - Most common species include Engelmann daisy, Maximillian sunflower, Gaillardia, Desmanthus spp., Mimosa spp., Viscia spp., Glandularia, Croton, and twist-leaf yucca. Rattlesnake master, Echinacea, shooting star, and Asclepias spp. are perennial forbs indicative of intact ecosystem processes.
 - Measures may include:
 - Annual production is 5-20% of total ANPP
 - Aerial cover is 25-75%
 - Frequency of occurrence is less than 50%
- Prevent and address erosion issues
 - Reduce occurrence of rills and gullies.
 - Channels are vegetated and stable or stabilizing.
 - Water flow patterns (distance of sediment and litter transport) are very short (e.g less than two feet).
 - Bare ground is rare (<5%) except after prescribed burns.

LONG-TERM ASSESSMENTS

In 2014, PARD commissioned a vegetation and fuel load survey from Raven Environmental Services. The resulting final report included information on

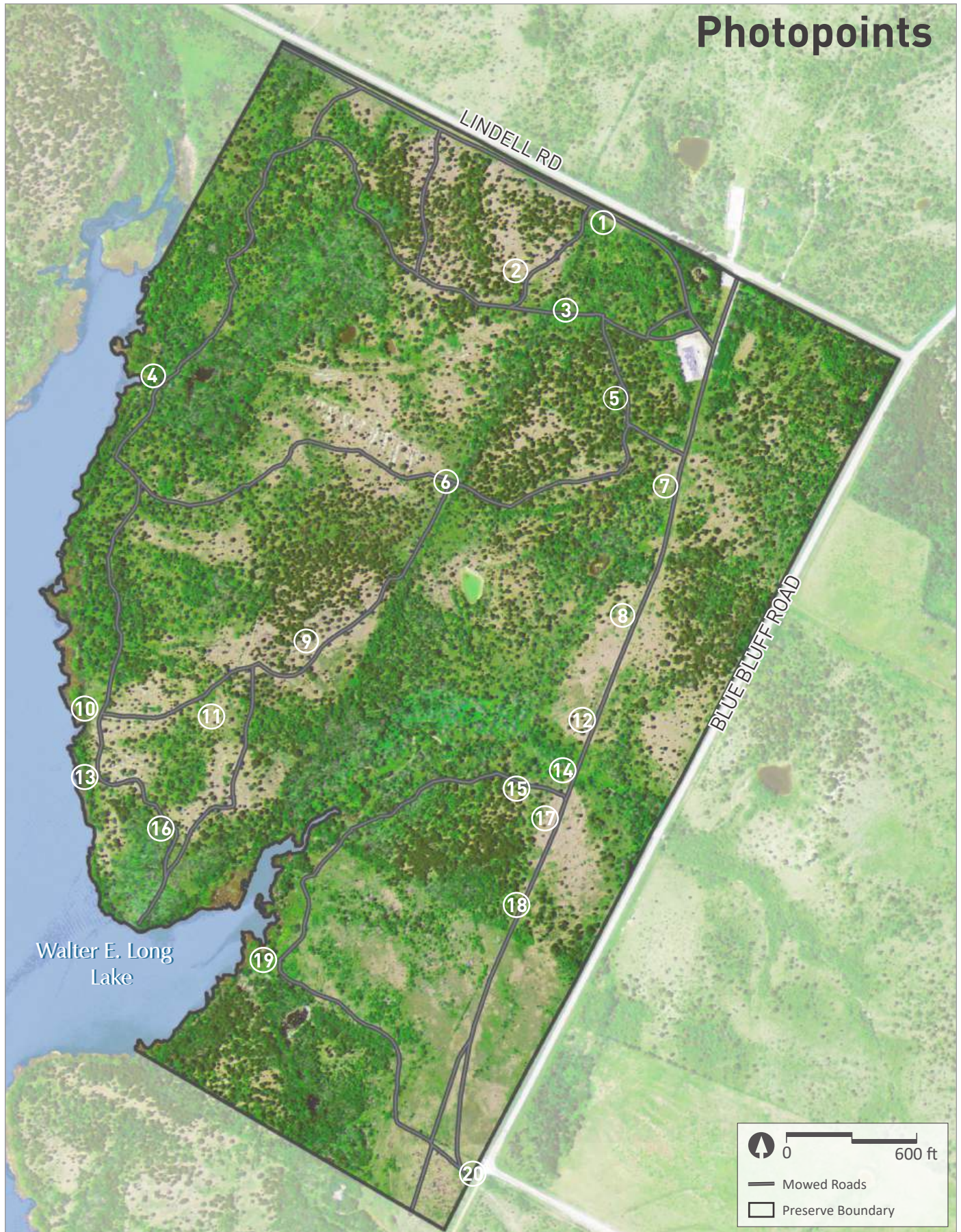


Figure 4.1. Photopoints.

existing vegetation, desired vegetation, and fuel modeling. In 2019, Siglo Group performed a site characteristics analysis, which included three site visits. In addition to these assessments, additional, more detailed surveys are recommended to serve as a baseline for restoration work.

Surveys needed to support restoration work in the coming years include invasive species surveys, erosion, and canopy cover assessments. These assessments will serve as a foundation for restoration work and will inform restoration efforts.

- Invasive species survey – A comprehensive invasive species survey and mapping to prioritize removal actions. This will serve as a baseline documentation of invasive species populations on-site. It should be updated as control or removal actions occur.
- Erosion assessment – Passive restoration of creek beds and drainages has been taking place since the site's acquisition in the mid-1960's. As restoration practices are implemented and as new developments take place on and off site, evaluation of creek erosion should take place every three years.
- Canopy cover assessment – Canopy cover should be assessed on a schedule relative to management actions. Canopy cover can be classified from aerial imagery in GIS and verified by on-the-ground monitoring.

MONITORING

The following monitoring practices are intended to occur on a frequency relative to management actions and will indicate the effects of restoration activities.

PHOTOPOINTS

Photopoints are a simple way to perform qualitative monitoring. Twenty photo points were established by Siglo Group within the study area in 2019 (Figure 4.1). Locations of the photopoints were chosen based on accessibility (to allow for easy repeat visits) and on representation of different areas of the preserve. The photopoints and descriptions are included in Appendix 3. GPS coordinates were taken at each location so that they could easily be

found and reevaluated. It is recommended that photos be taken once a year at each of these points. Comparing the photos over time will indicate how vegetation structure has changed and help guide future management decisions.

EARLY DETECTION MONITORING

Early detection monitoring detects new problems at an early stage of development so that they can be corrected quickly. This is considered a best management practice and is detailed in both the City's Urban Forest Plan and Invasive Species Management Plan.^{47,54} To perform early detection monitoring, a monitor should periodically visit the entire site to observe current conditions, including new problems such as new or expanding invasive species populations, areas being overused and denuded, new informal trails, and erosion. When new problems are identified, staff or volunteers can quickly act to address them. This prevents small problems from becoming larger ones.

To be effective, early detection monitoring requires a staff member, professional, or volunteer who is:

- Adept at identifying invasive species at all stages of development;
- Intimately familiar with the site over a long period of time (e.g. several years) and can determine how the site has changed; and
- Able to visit, often by walking, the entire site or portions of the site on a schedule that makes sense for the site's use and recent management (e.g. annually for restoration areas; more frequently for problem areas).

It is recommended that the following early detection monitoring information be recorded and stored electronically: date, observer, type of threat (e.g. species name, new invasive species, expanding invasive species patches, new or expanding erosion, new or expanding trampling, new or expanding informal trail, new or expanding stormwater flow), location (including latitude and longitude, along with general identifiers), size of issue (for invasive species this should include patch size, percent cover, and if appropriate number of plants), and a narrative description of the problem and potential cause. An example early detection monitoring template can be found in Appendix 4.

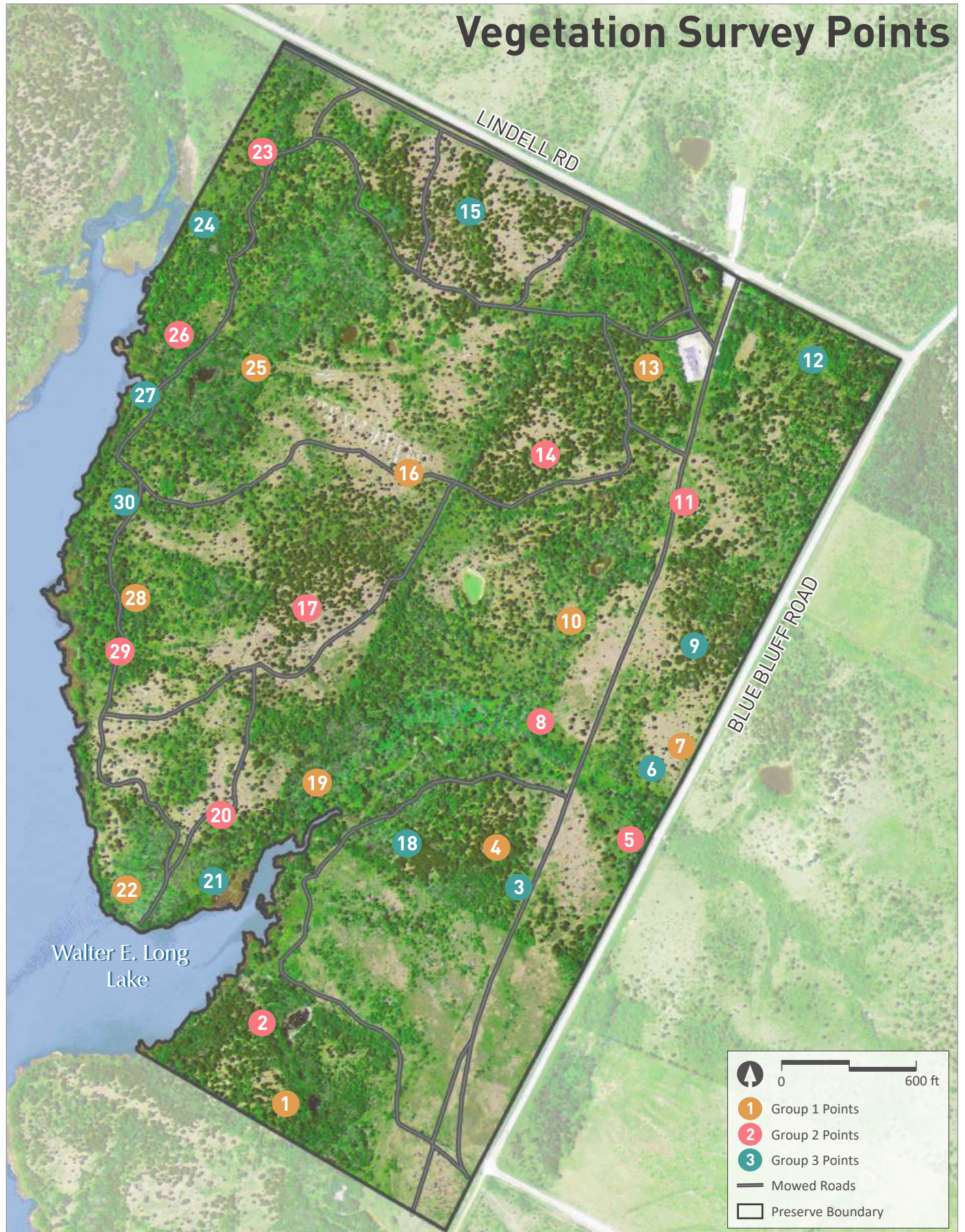


Figure 4.2. Vegetation Survey Points.

VEGETATION SURVEYS

Vegetation surveys and analysis allow land managers to understand, quantitatively, how plant communities are responding to management practices. They involve revisiting permanent plots, points, or transects to document characteristics of the plant community such as species present, abundance, cover, density, size class distribution, mortality, as well as abiotic factors such as ground cover (bare soil, plant litter, rock, etc.).

Discussions with the Barrera Wildlife Sanctuary staff have revealed a need for a vegetation survey protocol that can be implemented with relatively little time commitment from staff and volunteers but also yields meaningful information. In 2011, a vegetation survey of trees, shrubs, and herbaceous species was conducted in 30 plots (Figure 4.2). The following year, another plant survey was carried out. These plant surveys were intended to occur on a yearly basis but have not been repeated since 2012.

STRATEGY	REST REQUIREMENTS	
	pre	post
mechanical cutting/shredding	herbaceous cover is sufficient to protect soil from equipment	no fire until slash has aged (no longer fire control hazard); typically 1.5+ yrs
fire	fuel is sufficienct to create desired fire effects; burn 1-3 yrs	N/A
seed	soil has been prepared (e.g. by Rx fire)	N/A
herbicide	target plants undisturbed for 2+ yrs	treated plants undisturbed for 1+ yrs
goats	target plants are palatable and accessible	desired plants undisturbed 1+ yrs

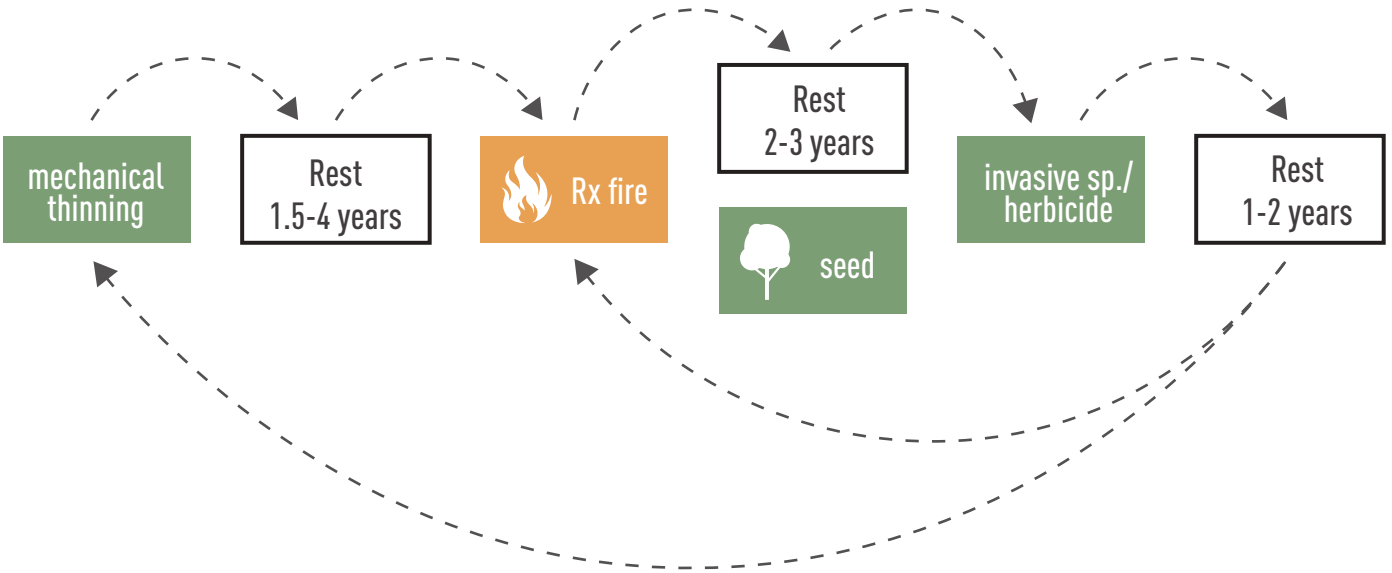


Figure 4.3. Management implementation and rest schedule and requirements

WILDLIFE MONITORING

While numerous species have already been identified, these surveys and observations are limited in scope and likely underrepresent the number of species actually present on the site. Knowing what species are currently on the site and which have been present in the past will give stewards a gauge of habitat quality. As wildlife species around the globe continue to lose their habitat to development and climate change, it will be increasingly important for managers to keep detailed accounts of wildlife visitation in order to inform management decisions. Camera traps are one way to conduct wildlife monitoring remotely. A major benefit of camera traps is the ability to continuously monitor an area for long periods of time, recording the movements of animals that are often reclusive and/or nocturnal.⁵⁵

SCHEDULE AND COORDINATION

The generalized land management schedule and details regarding rest periods is provided in Figure 4.3. This graphic can serve as a baseline of important tasks that should be considered for completion in the coming years.

MONITORING DOCUMENTATION AND FILE STORAGE

DOCUMENTATION

Prior to this plan, data were collected and stored in a variety of formats and locations. For monitoring data to be useful, they must be consistent, stored electronically, accessible, easily located, and in a format that allows for ready analysis. While data may be recorded on paper forms and manually transferred to electronic formats, field data applications (apps) such as Fulcrum, Collector for ArcGIS, or Survey123 can expedite or automate data entry in some cases. Quality control and often post-processing of data via manual cleanups and quality checks, however, are still necessary with use of mobile apps. To facilitate consistent record-keeping and storage, it is recommended that electronic records be kept of all management activities that include the following variables: date, recorder, general activity, area treated, location of area, size of area, how it was treated, and resources used (including labor), along with photo documentation.

FILE STORAGE

A sample file nesting structure has been included in Appendix 5.

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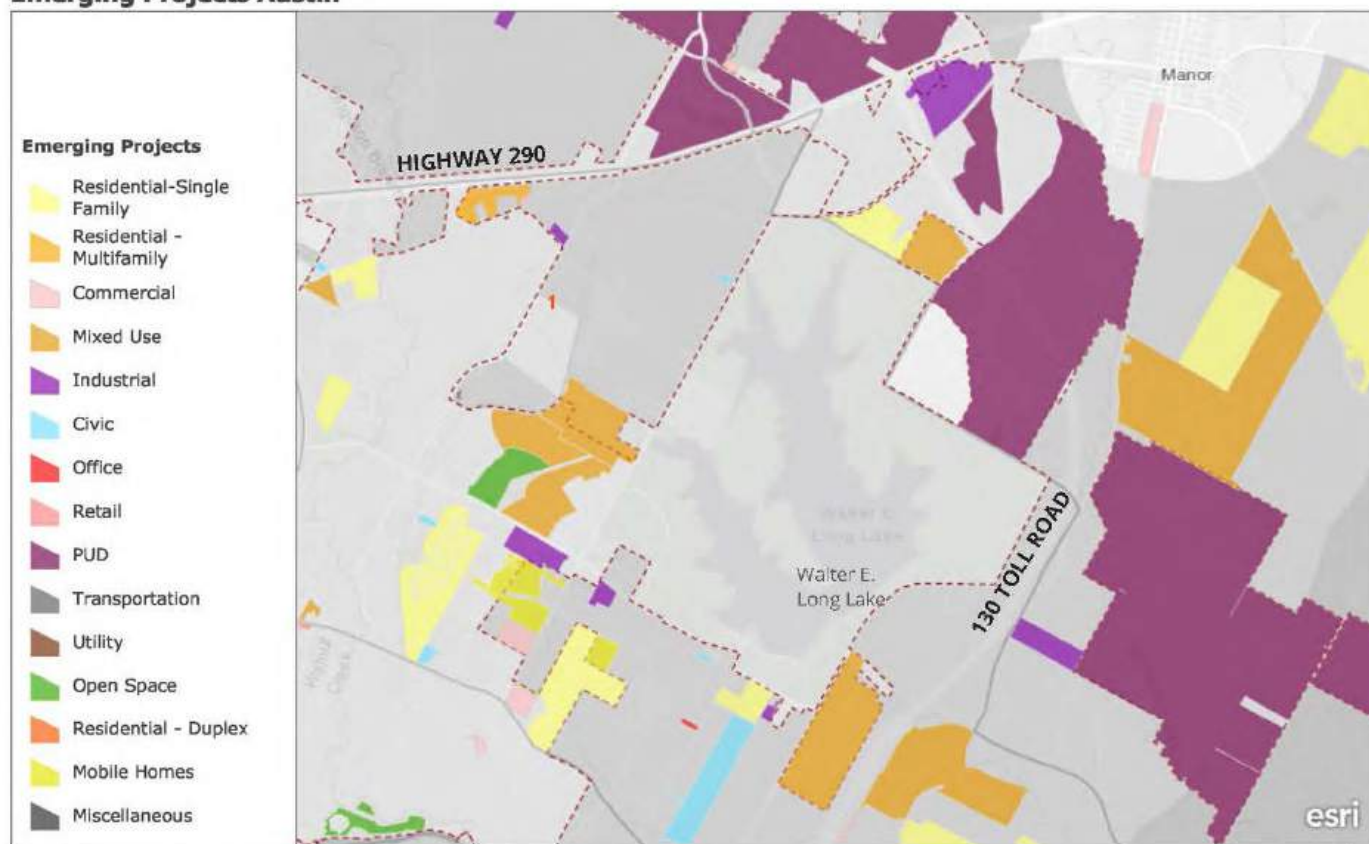
Appendix 1:

Future Development

from Walter E. Long Metropolitan Park Master Plan

The Emerging Projects Austin figure from the 2019 Walter E. Long Metropolitan Park Master Plan provides context of expected future development in the area surrounding the Barrera Wildlife Sanctuary.

Emerging Projects Austin



Some of the prominent projects in planning, or construction phases in or around Austin.

Sources: EPS, City of Austin Development Services Department, City of Austin "Emerging Projects" website, <http://www.arcgis.com/home/webmap/viewer.html?webmap=a7677079f571441f98f9ed8df5ece62f&extent=-97.9753,30.2645,-97.3124,30.6263>, accessed 27 April 2018

Appendix 2:

Proposed Trails

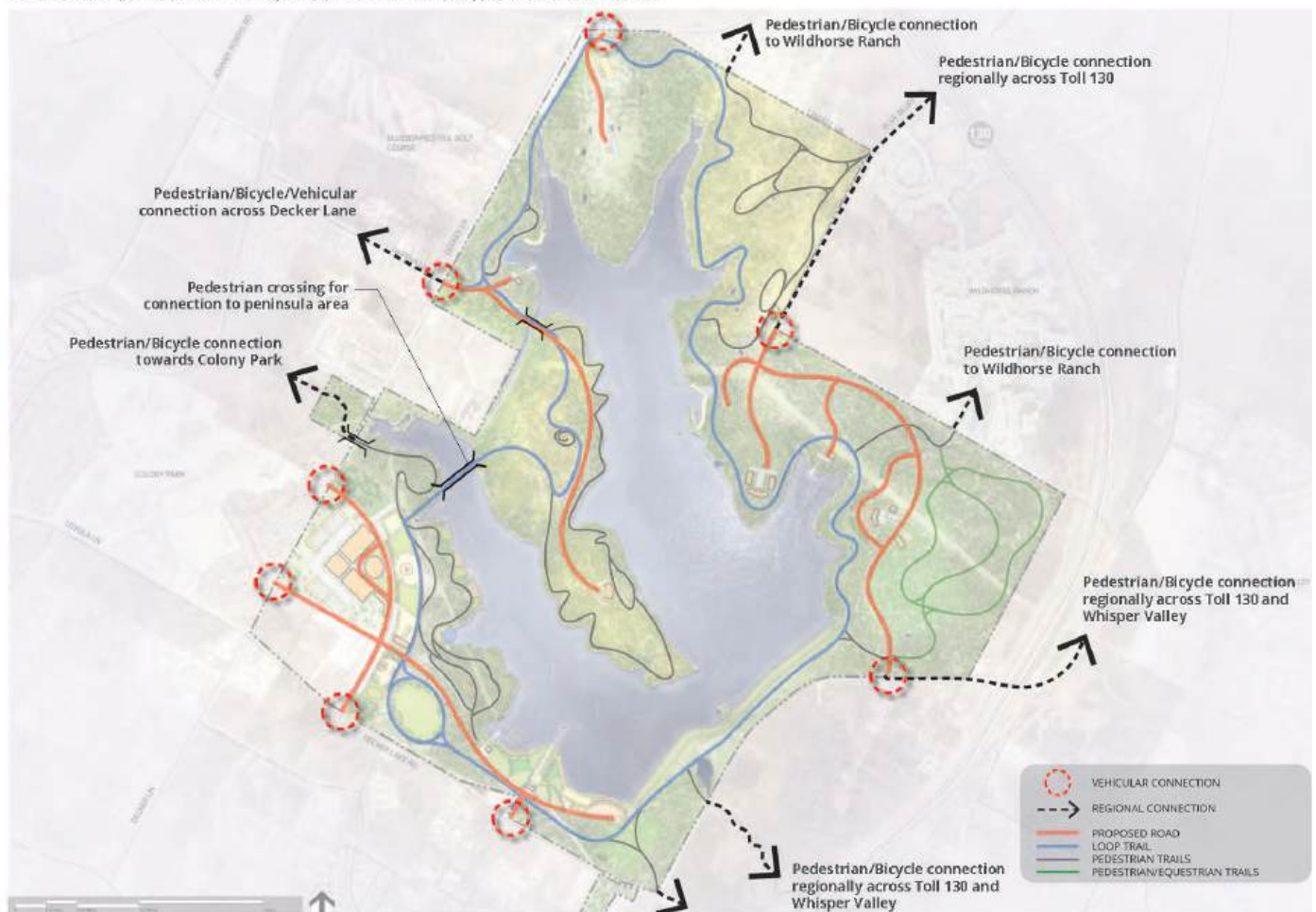
from Walter E. Long Metropolitan Park Master Plan

The Enhanced Access and Circulation figure from the 2019 Walter E. Long Metropolitan Park Master Plan shows proposed trail and road locations.

ENHANCED ACCESS & CIRCULATION

The final master plan features an extensive network of enhanced connectivity both within the park and regionally to the greater Austin area. This proposed circulation system offers visitors a better park experience through the provision of multiple types of amenities, such as:

increased roads and parking, pedestrian/equestrian trails and a loop trail which enhanced us access around the entire park.



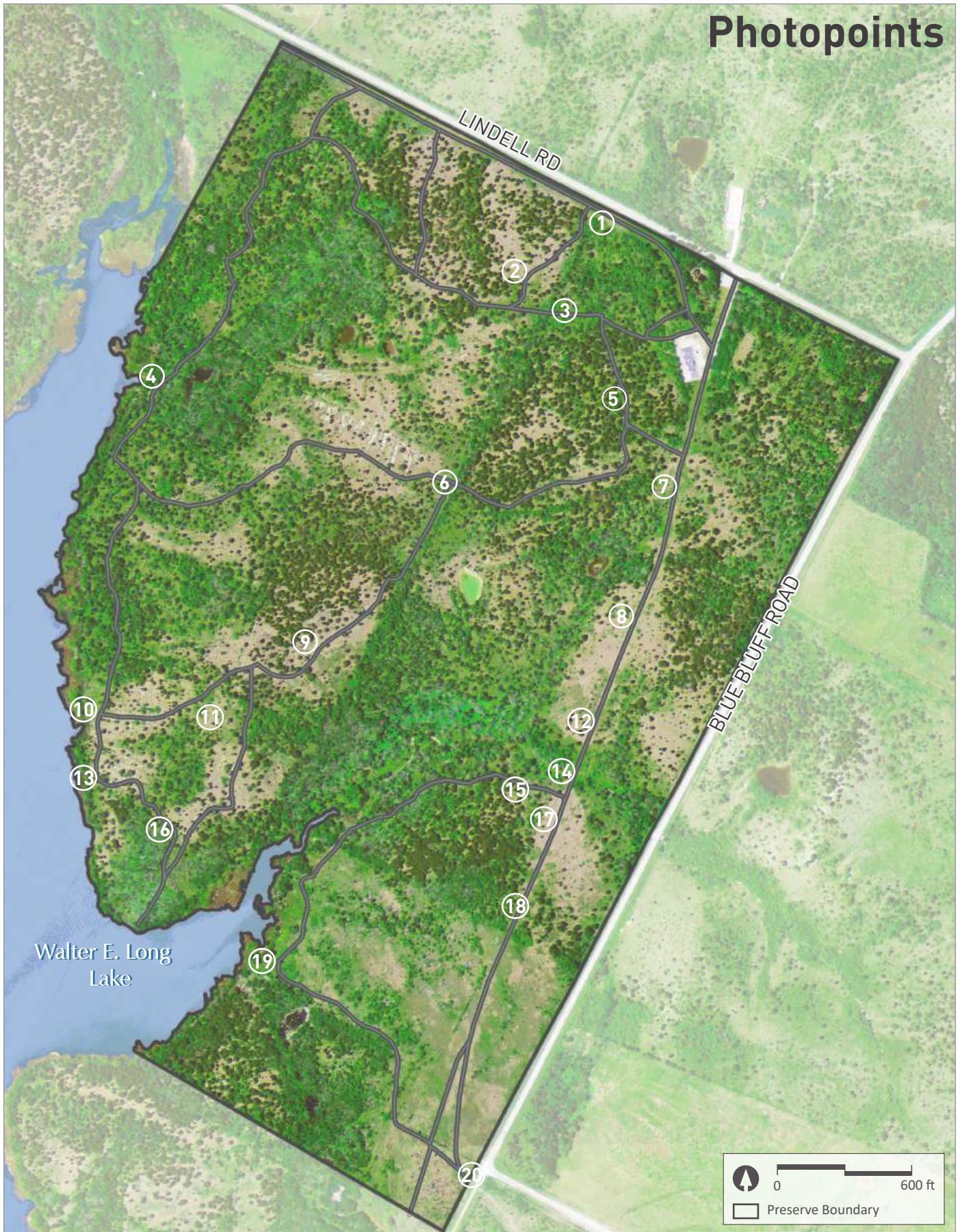
Appendix 3:

Photopoints

Photopoints are a fairly quick and easy way to perform qualitative monitoring. Twenty points were established within the Louis René Barrera Indiangrass Wildlife Sanctuary. GPS points were taken at each location so that they can easily be found, and the photos can be replicated. It is recommended that photos be taken once a year at each of these points. Comparing the photos over time will provide a sense of how areas are changing and guide future management decisions.

Photo Points	Latitude	Longitude	Collection Date
1	30.32118083	-97.589683	11-Nov-19
2	30.32057133	-97.59099233	11-Nov-19
3	30.32005433	-97.59026717	11-Nov-19
4	30.31932533	-97.59641067	11-Nov-19
5	30.31889217	-97.58960067	11-Nov-19
6	30.3178865	-97.59227717	11-Nov-19
7	30.31775533	-97.588838	11-Nov-19
8	30.3160745	-97.58952817	11-Nov-19
9	30.315847	-97.594245	11-Nov-19
10	30.31503933	-97.597552	11-Nov-19
11	30.314896	-97.5956985	11-Nov-19
12	30.31471733	-97.59016	11-Nov-19
13	30.31414567	-97.5975925	11-Nov-19
14	30.31410067	-97.59047233	11-Nov-19
15	30.31387067	-97.5913195	11-Nov-19
16	30.313481	-97.59645483	11-Nov-19
17	30.31347633	-97.59074533	11-Nov-19
18	30.312362	-97.5913225	11-Nov-19
19	30.31172617	-97.59499117	11-Nov-19
20	30.30891683	-97.59218567	11-Nov-19

Photopoints





PPT. 01

Direction: SW



Direction: W

These photos show areas in the northern portion of the site that were burned in Summer 2019.



PPT. 02

Direction: SE



Direction: NW

These photos show areas in the northern portion of the site that were burned in Summer 2019.



PPT. 03

Direction: NW

These photos show areas in the northern portion of the site that were burned in Summer 2019.

PPT. 04 - PPT. 06



PPT. 04

Direction: S

Dense woody vegetation lines the shore of Walter E. Long Lake



PPT. 05

Direction: NE



Direction: NW

The first photo (NE direction) shows an area burned in Summer 2019. The second photo (NW Direction) shows an area just outside of the unit burned in 2019. The condition and coverage of woody vegetation shown in the two photos illustrates the impact of the burn.



PPT. 06

Direction: N



Direction: E

These photos show areas in the northern/central part of the preserve. They vary from grassy to woody, but the areas outside of the mowed paths have a relatively closed canopy.

PPT. 0 - PPT. 0

PPT. 07- PPT. 09

**PPT. 07**

Direction: W

The area along the pipeline right of way in the northern/central preserve is a combination of grassland and juniper woodland.

**PPT. 08**

Direction: S

The area along the pipeline right of way in the northern/central preserve is a combination of grassland and juniper woodland. In this photo, the foreground is mostly grassland, but there is juniper woodland in the background.

**PPT. 09**

Direction: N

This central portion of the preserve was burned in 2016. Much of the area is now dominated by King Ranch Bluestem.

PPT. 10 - PPT. 12

PPT. 0 - PPT. 0



PPT. 10

Direction: E



Direction: W

The first photo (E direction) shows a mix of King Ranch Bluestem-dominated open areas and Juniper woodland. The second photo (W direction) shows the shoreline vegetation.



PPT. 11

Direction: E



Direction: SW

These photos are taken from near the top of one of the small hills on the preserve. They show a mix of King Ranch Bluestem-dominated open areas and Juniper woodland along with Walter E. Long Lake in the background of the second photo (SW direction).



PPT. 12

Direction: N

This photo shows one of the more open grassland areas adjacent to the pipeline right of way in the central part of the preserve.

**PPT. 13**

Direction: SE

Dense juniper woodland lines the mowed path.

**PPT. 14**

Direction: E

These photos show a combination of dense woodland and more open grassy areas.



Direction: W

**PPT. 15**

Direction: SW

Brush clearing has been done in preparation for prescribed burns.

PPT. 16 - PPT. 18



PPT. 16

Direction: NE

Open grassy areas surrounded by dense woodlands.



PPT. 17

Direction: S

An open grassy area adjacent to the pipeline right of way.



PPT. 18

Direction: N

The view along the pipeline right of way from the top of a small hill shows the extent of woody encroachment beyond the immediate foreground.

PPT. 19 - PPT. 20

**PPT. 19**

Direction: E



Direction: W

The first photo (E direction) shows dense growth of shrubs. The second photo shows shoreline vegetation including large willow trees.

**PPT. 20**

Direction: N



Direction: W

The southeastern corner of the preserve is the most intact example of grassland on the preserve.

Appendix 4:

Monitoring Documents

Early Detection Monitoring Datasheet

Date: _____ Recorded by: _____

Type of Threat:

- ☐ New Invasive Infestation; Species Name(s): _____
- ☐ Expanding Invasive Infestation; Species Name(s): _____
- ☐ New or expanding erosion or denuding of vegetation; describe: _____
- ☐ New or expanding informal trails; describe: _____
- ☐ Other; describe: _____

General Location (landscape character area or areas if known) _____

Specific Area: _____ latitude: _____ longitude: _____

Disturbance: (circle applicable)

Flood Graded Mowing Recently cleared Recreational traffic Storm damage Roadside

Patch Type: (circle applicable)

Point (one or few invasives or locations) Linear (erosion or invasives extending along a line) Polygon (of non-linear type)

Rare (hard to find, other plants more common)

Common (one of the common plants in area)

Notes:

Stewardship Activity Log

Date: _____ Recorded by: _____

General Activity: _____

Example include: tree planting, invasive plant inventory or removal, seed sowing, trail maintenance, soil enhancement, monitoring of past activities, monitoring of trail conditions, etc)

General Location (landscape character area or areas if known) _____

Specific Area _____ latitude: _____ longitude: _____

Photos Taken and Attached Yes No

Activity and/or Monitoring Details:

Example include: number of trees planted, method of removal, herbicides used, number of volunteers utilized, time spent, etc. For monitoring, examples may include tree mortality or qualitative description of success]

Appendix 5:

Data Storage

Barrera Wildlife Sanctuary Folder Prototype

